The Journal

OF THE

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THE TEMPOROMANDIBULAR JOINT AND THE AUDITORY FUNCTION

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I. INTRODUCTION

A SUBJECT of increasing interest in recent years is the relation between the intermaxillary vertical dimension and auditory acuity. Both the dentist and the otolaryngologist have concerned themselves with this problem, and widely differing interpretations of the effects of condylar displacement upon the auditory mechanism have been expressed in a long list of publications.

An editorial in THE JOURNAL[1] calls attention to this current interest, giving a succinct account of its development. The editor raises a "note of warning against superficial diagnosis leading to the operation of opening the bite in practically all cases where the hearing is affected or where there are neuroses of the face and jaws, the etiology of which cannot readily be recognized." He also states that "the most conscientious and well-intentioned efforts may result in failure, unless accompanied by an intimate knowledge of the anatomy, pathology, physiology and histology of the structures."

Winning essay in nation-wide essay competition sponsored by the Chicago Dental Society, February 1943.

From the Department of Anatomy, College of Physicians and Surgeons, Columbia University.

SURVEY OF THE LITERATURE

A review of the recent literature reveals considerable controversy regarding defects in auditory function that are attributed to various changes within the temporomandibular joint. Changes in the bony and cartilaginous structures were reported by Prentiss,[2, 3] who writes[2]:

> If the teeth are removed, the condyle is pulled upward by the powerful musculature, and pressure is brought to bear upon the meniscus, with a resulting atrophy varying from a small opening to a ring of cartilage in many ways resembling the semilunar cartilages of the knee. This pressure in old cases is carried to such a degree that not only is the hyaline cartilage covering the condyle and the temporal surfaces destroyed, but also the bones themselves show marked pressure atrophy. The glenoid cavity, in one case, is

so excavated that the plate of bone between the condyles and the brain cavity is *nil*.

Similar references to resorption of bone and cartilage due to condylar pressure have been expressed in a number of more recent publications.[4-10] Schopper,[4] in 1938, wrote:

> By the closing of the bite, the meniscus becomes atrophied, sometimes developing perforations. This creates a loose joint, followed by erosion of the tympanic plate and the glenoid fossa, leaving only a thin wall between the condyle, the ear and the dura.

A number of other publications[11-15] have challenged the view that loss of teeth causes condylar pressure resulting in erosion of cartilage and bone within the joint. Higley,[13] in one of these articles, said:

> Some investigators attach importance to the effect of erosion of the glenoid fossa and tympanic plate, thus accounting for involvement of the hearing mechanism and the dura. I feel that there has been nothing but speculation on the question as to whether such erosion is ever produced by action of the mandible. It is possible that what seems to be erosion is in reality a congenital defect.

According to Conners,[11] "the evidence presented by Dr. Prentiss can be explained on the grounds of inflammatory processes and congenital defects." Gillis,[12] also disagreeing with the theory that the interarticular cartilage thins out and disappears, with the result that the condyle actually wears against the fossa, stated that "when the edentulous patient tries to masticate, the condyle is pulled *away* from the fossa."

Malposition or retrusion of the mandibular condyle in the glenoid fossa has been suggested as a cause of deafness in a number of publications.[16-19] Wright[16] maintained that "any combination of losses (of teeth) which allows the jaws to approximate each other in what is termed a closed bite with continued effort on the part of the patient to retrude the mandible during mastication should be regarded as a possible cause of existent deafness." McGrane,[17] concurring in this view, expressed the belief that "traumatic deafness . . . is the result of malposition of the mandible existing over a period of years, due to gradual abrasion or erosion of the natural teeth; loss of several or all of the teeth, or faulty restorations, operative or prosthetic," and Jamieson[19] concluded that "malposition of the condyle may cause, among other symptoms, otosclerotic deafness."

Deafness has also been attributed to occlusion of the external auditory meatus brought about by condylar displacement in the closed bite case.[6, 7, 17, 18, 20-22] Monson[21] writes:

> Closing of the bite is the prime factor in producing the backward movement of the condyle, which then encroaches upon the external auditory meatus and often causes a resultant defect in hearing in a degree proportionate to the amount of the encroachment. We find some cases where the canal is entirely closed.

Harris[7] substantiated this opinion, stating that any condition allowing the patient to close the mandible beyond the point of greatest efficiency which he developed with the natural teeth thrusts the condyles back into the non-articulating portion of the fossa, causing from a slight intrusion to a complete closure of the auditory canal. Other authors[23-27] hold that deafness is due to conditions other than direct malposition of the condyle. Among these, Babbitt[23] reported cases in which patients had worn artificial blocks to open the bite, but stated that he had not been able to demonstrate relief of deafness or tinnitus by relieving condylar pressure.

A number of authors[8, 13, 18, 25, 28-35] attribute deafness to occlusion of the eustachian tube brought about by the loss of teeth and a resulting lessening of the intermaxillary vertical dimension. Among these, Smith[28] explains the manner in which the tube is occluded by the

statement that a closed bite displaces the tongue backward, thereby forcing the adjacent movable or soft parts into abnormal positions; adding that, "the soft palate and its attachments place great pressure on the pharyngeal opening of the tube, which lessens the patency of the cartilaginous portion of the tube itself." He continues: "This pressure displacement must of necessity not only lessen the lumen of the tube but also lead to inflammation and other morbid conditions, and in addition, doubtless causes atrophy of the palatine muscles through which it is controlled." He also states that the so-called deafness of middle life would be better described as deafness of the closed bite, for middle life is but coincidental. Costen[29-30] reported that, in a series of sections through the joint and ear structures, a plane was found in which, when the jaw of the soft tissue specimen was overclosed manually (to simulate overclosure in life), all soft tissues next to the eustachian tube, including the tensor veli palatini muscle, bordering the membranous anterior edge of the tube, and the adjacent sphenomeniscus muscle, were seen to wrinkle and close the tube firmly. Fowler[26] has called attention to the fact that although the deafness of middle life coincides with the loss of teeth in the third decade and although such loss may be one of the causes of hearing loss, it is only one of a number of conditions that have a bearing on a lessening of auditory acuity.

Still another cause of deafness ascribed to conditions within the temporomandibular joint is pressure upon neighboring blood vessels and nerves. Among those publications[13, 36, 37] which include this view is that of Bleicker,[37] who stresses the need for a fundamental knowledge of the temporomandibular joint as well as of the physiologic action of the joint, pointing out that "the anterior tympanic artery, which supplies the anterior two-thirds of the tympanic membrane, and the chorda tympani, which passes between the malleus and incus, pass through the petrotympanic fissure; therefore, pressure of the head of the condyle on the artery and nerve would create an ear disturbance." Goodfriend[36] asserts that "the influence of mandibular joint disease in the etiology of deafness is predisposing by trauma and inflammation, and exciting by reflex influence upon the auriculo-temporal nerve."

Neurologic conditions have been discussed as a cause of deafness in both the dental and the medical literature. Among a number of investigators,[18, 19, 24, 38-42] Chor[18] suggested that it must be determined whether deafness is due to an extraneural disease process or to nerve involvement. He also stated, that, from the neurologic point of view, there is no indication that the eighth nerve is involved in temporomandibular disorders. Dingman,[41] referring to Costen's syndrome, emphasized the need for further investigation of the subject in the light of other symptom complexes and other causes of headache, neuralgia, glossodynia and ear disturbances, that errors in therapy might be minimized.

Edmund[31] stated that "dentistry has reached that stage of advancement when it not only stands ready to aid the otolaryngologist in the diagnosis of ear syndromes, but also offers scientific, proved mechanical corrective measures for repositioning the condyle." A number of other publications[1, 14, 27, 34] have stressed the fact that caution should be exercised in opening the bite. Mershon,[27] calling attention to the dangers associated with this procedure, deplored the fact that "some men have gone so far as to assert that they can relieve deafness by opening the bite."

VARIOUS TYPES OF DEAFNESS

What constitutes deafness? The impairment or total loss of the sense of hearing may result from a plug of cerumen in the external auditory meatus; or it may be caused by obstruction of

the eustachian tube or a middle ear infection, or by interruptions in the ossicular chain due to dislocations or ankylosis, causing conduction lesions.

The conductive type of lesion that causes an impairment in hearing may be designated as one in which the auditory nerve, being normal, can perceive the bone vibrations of a tuning fork (Weber test), yet has no appreciation of air vibrations (Rinne test).

The neural lesion, resulting in loss of hearing, is designated as one in which any part of the nervous auditory pathway is destroyed. Such a lesion may result from destruction of nervous elements within the cochlea (labyrinthine deafness), otosclerosis and loss of nerve cells accompanying the advance of age (progressive deafness); tumors and fractures involving the eighth nerve along its course, or apoplectic hemorrhage occurring along the central auditory pathway within the brain. In all such instances, the actual nervous elements have been destroyed, and there is perception of neither air nor bone vibrations.

After determining whether hearing loss is due to the conductive or nervous type of lesion, it is essential to ascertain which tones are involved, by means of electrical audiometric tests.

A complete analysis of the physiology of hearing is beyond the scope of this communication, but a brief explanation of terms used in the subsequent paragraphs may be useful. The various tones are designated by numbers called frequencies (number of vibrations or cycles per second). Thus the range of hearing tone in man is pitched from 128 frequencies to 8,192 frequencies. Conversational tones fall primarily between the frequencies 512 and 1,300; all tones between 128, and 4,096 cycles per second are called low tones, while those above 4,096 frequencies are designated as high tones. The audiometer is an electrical apparatus which provides pure test tones at any desired frequency from 128 to 9,747 cycles per second. With appropriate receivers, tests can be made of the patients' hearing loss at various frequencies either by air conduction or by bone conduction. The results of the threshold sensitivity for every tone tested, when tabulated, constitute a permanent graphic record, or audiogram.

A differential diagnosis of this kind requires not only a specialized knowledge of the anatomy and physiology of the middle and inner ear, but also a sound-dampened and sound-proofed room fitted with costly equipment, plus adequate testing in order to eliminate a wealth of possible errors and extraneous sounds. All or most of these requirements are outside the training and means of the majority of dental practitioners. The preparation of audiograms in relation to this problem and a discussion of the technics and errors involved in such procedure can be found in a number of recent publications.[15, 43, 44]

Because the current literature still contains controversial interpretations of the problem, and because, in a number of instances, authors have stressed the need for a better correlated knowledge of the anatomy and physiology of both the temporomandibular joint and the ear, it seems that a clarification of both joint structure and auditory function is still required in order to aid in establishing the possible relations of the joint condition to hearing in cases wherein the intermaxillary vertical dimension is lessened owing either to occlusal abrasion or to loss of teeth.

II. Observations and Discussion

An extensive anatomic description of the temporomandibular joint *per se* is unnecessary, since a complete discussion can be found in all of the standard textbooks of anatomy as well as in many other publications.[2, 3, 11, 45, 46] However, one is impressed by the frequent vague references to structures lying medially (deep) from the condyle of the mandible.

This is particularly true of the sphenomeniscus muscle (superior fascicle of the external pterygoid), chorda tympani, auricular temporal nerve, sphenomandibular ligament, tensor and levator palatini muscles and eustachian tube. A clear demonstration of these anatomic entities and their respective relationships is essential, since one or more investigators have stressed the significance of each in attempting to correlate overbite and auditory function.

MATERIALS AND METHODS

In order to recall these intimate relationships of the mandible, skull and adjacent soft structures, we have prepared appropriate coronal and frontal section drawings from frozen (dry ice) specimens. We believe that such preparations, when thoroughly oriented, aid one in attaining a three dimensional understanding of this complex area. Lateral and basal views of the skull have been included, to demonstrate bony landmarks and orient the planes of the sectional specimens. Microscopic studies of the inner ears of aged rats, stained with silver, have been included to demonstrate neurologic findings in these laboratory animals.

ANATOMIC CONSIDERATIONS

Conditions in the Temporomandibular Joint Which May Affect the Hearing.—Erosion of bony portions of the joint: Erosion of the tympanic plate, with subsequent condylar occlusion of the external auditory meatus and loss of auditory function, has been mentioned above. The bony relationships of condyle, tympanic plate, postglenoid tubercle and external auditory meatus in an edentulous skull are shown in Figure 1. Here, as in other edentulous specimens that we have examined, we have failed to find any appreciable bony erosion of the tympanic plate. Similarly, we have never observed a complete perforation of the roof of the mandibular fossa as a result of condylar erosion. Although the squamae in a few specimens are extremely thin, the dura of the middle cranial fossa has always been protected by a shelf of extradural bone.

Condylar occlusion of the external auditory meatus: Is it possible for condylar displacement to occlude the cartilaginous portion of the external auditory meatus? This can be studied by manipulation of a dried skull. Forcible medial pressure on one side of a mandible with both condyle heads in the mandibular fossae will serve to demonstrate the amount of lateral displacement of the opposite condyle. The elevation of the angular spine of the sphenoid bone medially (3, Fig. 2) will not permit the condylar head of the opposite side to move beyond the postglenoid tubercle. This anatomic limitation, in addition to the absence of any appreciable erosion of the tympanic plate in the bony portion of the meatus, tends to minimize the rôle of condylar pressure in occluding the external meatus, or as a factor influencing auditory function. It should also be noted here that determination of condylar movement and pressure by index palpation through the anterior wall of the cartilaginous meatus is a questionable procedure, for the movement one detects by this method is not confined to the head of the condyle. Parotid gland tissue and other soft retromandibular structures which undergo special readjustments during the movement of the mandible fill the intervening area between the point of palpation and the posterior surfaces of the condylar head.

Perforation of the articular disk: We have examined dissections of the temporomandibular joints of more than one hundred human cadavers in which the dentition varied from a full complement of teeth to the edentulous condition. In no case have we seen a perforated articular disk. Although we have found references to such a condition in the

literature, it is our belief that perforation of the articular disk must be a rather rare occurrence. We have, however, noted the marked dissimilarities in size and contour and in the degree of wear shown. The areas in which wear occurs, as evidenced by a thinning of the disk, vary in all of the cases observed. The condylar heads also are of differing appearance, not only in different individuals, but also on the two sides of the same individual. In the latter observations, we concur with the findings of Lord,[45] who made studies of articular disks from both sides of more than fifty skulls with good dentition, and found that not only were no two alike as to size, shape and relative thickness, but also the differences were considerable.

The drawings of the dissected material shown in Figures 3 and 4 illustrate the relations of the bony condylar head to the meniscus, the capsular ligament and the external pterygoid attachment. Drawings from dissections of nine different individuals (Fig. 5) illustrate the variations in size and contour of the condyle heads and the areas of wear in the articular disks (shown as more lightly shaded areas). It should be noted that the thinning of the disk occurs in the more anterior and medial portions, areas which are difficult to visualize by means of roentgenographic technic.[47]

Arterial occlusion: Is it possible that malposition of the mandible may occlude adjacent arteries and impinge upon branches of the trigeminal and facial nerves, thus inducing otosclerosis and reflex impairment of auditory function?

The internal maxillary artery (10, Fig. 9) and its deep auricular, anterior tympanic and middle meningeal (3, Fig. 9) branches may be affected in joint disorders. The deep auricular and anterior tympanic arteries and the superior tympanic branch of the middle meningeal artery are of significance because they supply the tympanic membrane and mucosa of the middle ear.

It is doubtful, however, that condylar occlusion alone of one or all of the foregoing arteries in young individuals would induce a sclerotic condition of sufficient severity to seriously alter auditory function. This belief is based on the existent anastomosis within the mucosa between the maxillary tympanic arteries and the tympanic branches of the stylomastoid, ascending pharyngeal and internal carotid arteries. The tympanic membrane also receives collateral auricular branches from the occipital and posterior auricular arteries.

Although condylar occlusion of these arteries in young patients undoubtedly produces negligible sclerosis within the middle ear, such an arterial obstruction in older patients already having an extensive arteriosclerosis might increase auditory defects. This problem, however, must await further investigation regarding the etiology of otosclerosis and the facts relating age with arteriosclerosis, the studies of Hughson and Crowe[48] and Lempert[50] having already stimulated interest along this line of approach.

The membranous cochlea and auditory (eighth) nerve are in no manner dependent on arteries adjacent to the mandible as a source of nutrition. These structures receive their arterial supply from the internal auditory artery (19, Fig. 8), which arises from the basilar artery within the skull, and accompanies the seventh and eighth cranial nerves as they pass laterally into the internal auditory meatus. Since the patency of this artery maintains the integrity of the eighth nerve and the membranous labyrinth, it is of greater importance in audition than the vessels discussed above.

Reflexes and referred pain: Reflexes and referred pain resulting from abnormal positioning of the mandible are extensively discussed in the recent dental literature, particularly those involving the chorda tympani (3, 10, Fig. 8; 17, Fig. 9) and the auricular temporal nerves (8, Fig. 8; 18, Fig. 9).

Trigeminal nerve. Costen[51] has described reflex trismus resulting from irritation of the sensory branches of the mandibular nerve. This interesting clinical observation of a reflex, involving only the trigeminal nerve, serves as an excellent example of the manner in which mandibular position may influence auditory function.

Irritation of the auriculotemporal nerves may bring about and maintain reflex contraction of the tensor tympani muscle through motor fibers of the trigeminal nerve, which pass through the otic ganglion to supply the muscle. Anything that interferes with the normal tension existing among the tympanic membrane, the ossicles and the contents of the oval window will cause tinnitus and deafness (Ballenger's physiologic law). If the tensor tympani muscle (13, Fig. 8) were reflexly thrown into tonic spasm, one might expect to find symptoms similar to those produced in experimental animals by hanging 5 to 50 gm. weights on its tendon. Crowe[49] and Crowe, Hughson and Witting,[52] in such investigations, found a marked loss of low tones, reporting that "with extreme tension on the tensor tympani muscle and the consequent fixation of the ossicular chain, transmission of all tones below 2,048 can be reduced until they are no longer audible."

Facial nerve. The chorda tympani and sensory branches of the facial nerve may possibly be responsible for loss of low tones by a seventh nerve reflex arc. Through its motor fibers, this nerve supplies the stapedius muscle, which acts upon the base of the small stapes bone. Tonic spasm of this muscle tends to fix the stapes and simulates the experimental results of separating the incudostapedial joint[49, 52]; namely, loss of spoken words and all pure tones up to 1,024 double vibrations per second. The higher tones (with frequencies of 2,048 and 4,096) are still transmitted, though with greatly reduced intensity.

Although such reflexes of the fifth and seventh nerves are morphologically possible, and similar conditions have been produced in experimental animals, their actual existence and effects have never been demonstrated or ascertained in the edentulous patient or in cases of temporomandibular joint disturbances.

Diagnostic Value of Roentgenograms of the Joint.—The diagnostic value of roentgenographic examination of the temporomandibular joint has been stressed in a number of publications.[8, 12, 13, 32, 35] According to Riesner[8]:

> If the articulating surfaces of the temporomandibular joint are brought into traumatic relations, something is going to give away; the articulating disk, the condyle head, articular tubercle, or the mandibular fossa, one or all, with secondary involvement to the contiguous structures such as the ear or the terminal structures, the teeth . . . the roentgenograms, however, reveal each individual peculiarity and permit us to make our corrections according to the individual requirements.

He writes later[35]:

> The correct vertical dimension between maxillae and mandible (restored by the full complement of teeth) is established through the agency of properly projected and interpreted roentgenograms of the temporomandibular joint coupled with correct clinical examination. Decision to open the bite should rest largely on dental grounds.

In 1938, Kieffer[53] and Moore[54] introduced the laminagraph, a device for roentgenographic body sectioning in which a circular or spiral motion can be employed for elimination of troublesome superimposed shadows on the film. In 1939, Petrilli and Gurley[55] reported that roentgenograms of the temporomandibular joint were found unsatisfactory because of the superimposition of other structures. They stated that pictures of great diagnostic value can be obtained by means of tomography, this method being based on recording a plane section of solid objects at a given point, with

elimination of structures above and below. These newer methods of examination may offer additional assistance in interpreting the roentgenograms of the temporomandibular area. Roentgenograms of the joint made with the laminagraph and which we have seen, however, do not give the true picture of the joint structures, which we believe must be obtained if the film is to be used for diagnostic determinations of changes occurring within the joint region.

In 1941, Junemann[15] reported examining a number of roentgenograms of the temporomandibular joint and stated that "in none of the roentgenograms of the abnormal cases was there any visible evidence of irregularities, bone destruction, and any other abnormalities of any of the bony joint structures." In a case under treatment and observation from 1938 to 1942[56] in which subluxation of the condyle on one side of the head had been a frequent occurrence, roentgenograms of the temporomandibular joint, taken at intervals of three to four months during the entire period, showed no readable evidence of structural changes within the joint cavity, although the bite had been opened considerably by building up the occlusal surfaces of the mandibular molars with splint devices.

Our observations of dissected temporomandibular joints and of roentgenograms of the joint area have led us to conclude that although the roentgenogram of the joint is undoubtedly of value in recording the relation of the more lateral and posterior surfaces of the condylar head and genoid fossa, its lack of evidence as to the greater three dimensional area of the joint places definite limitations upon its value for diagnostic purposes. As Fowler[26] has so aptly remarked, "If only someone will assemble a cine-lamino-fluorograph which would be better able to focus the picture on a single plan, some of our problems may be solved."

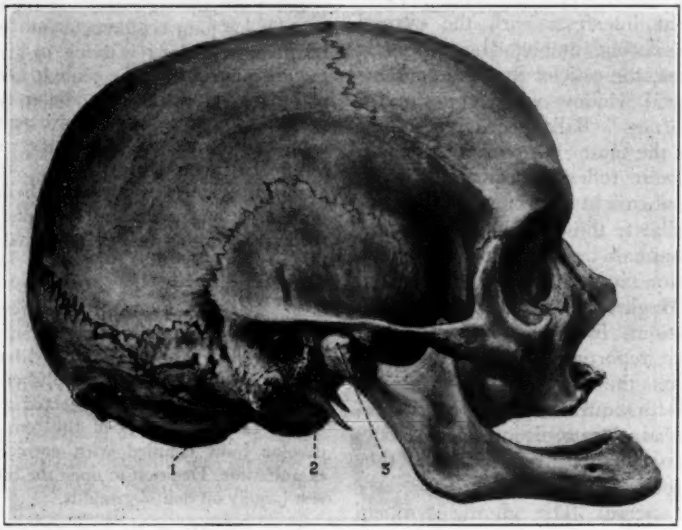

Fig. 1.—Bony relations of temporomandibular articulation in edentulous skull. 1, external auditory meatus and tympanic plate. 2, petrotympanic fissure and postglenoid tubercle. 3, head of condyloid process and articular tubercle.

Occlusion of the Eustachian Tube.—

That the normal functioning of the eustachian tube regulates intratympanic pressure is well known, but only in recent years have we become aware of the type of hearing loss which results from tubal occlusion; namely, a decrease in perception of higher tones.

Direct condylar pressure: Is direct condylar pressure a factor in occluding the eustachian tube, thereby preventing equalization of pressure between the nasopharynx and the tympanic cavity? What are the anatomic relationships of the mandibular condyle to the tube?

The relationships of the mandibular fossa, eustachian tube and palatal muscles that open the tube are illustrated in Figure 2. As shown in this drawing, the tensor and levator veli palatini muscles strap the tube, as they take partial origin from the respective lateral, inferior and middle surfaces of its cartilage. The direction of muscular action on the soft palate as the tensor and levator pull toward

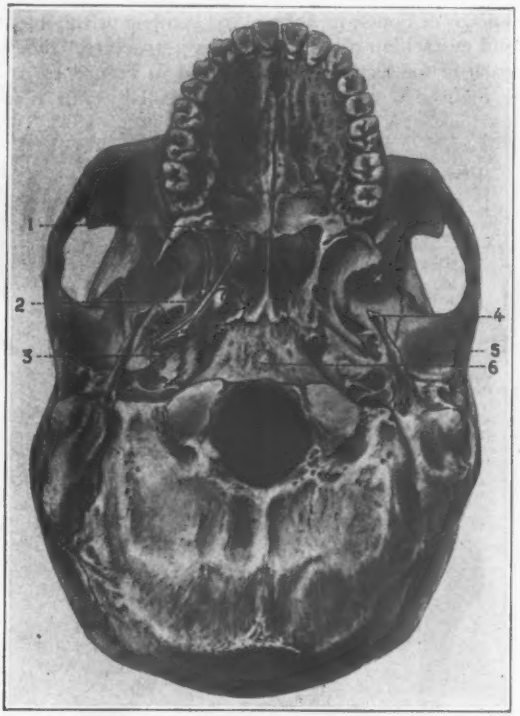

Fig. 2.—Base of skull. The eustachian tube and origins of the veli palatini muscles have been inserted on the right side. Arrows indicate the action of these two muscles on the soft palate. The left infratemporal fossa is indicated by X. 1, lateral pterygoid plate and hamulus of medial pterygoid plate. These bony plates form lateral and medial boundaries of the scaphoid fossa. 2, foramen ovale and origin of tensor veli palatini. The additional origin of this muscle from the anterior and lateral surfaces of the eustachian tube is indicated. 3, tympanic plate and origin of levator veli palatini muscle from angular spine of sphenoid bone and inferior and medial surfaces of eustachian tube. 4, articular tubercle and styloid process. 5, mandibular fossa. 6, orifice of carotid canal and origin of superior pharyngeal constrictor muscle from pharyngeal tubercle.

their origins is indicated by arrows (2 and 3, Fig. 2).

The soft structures which fill the space between the condyle, mandibular fossa and cartilage of the tube are difficult to visualize in a single plane. However, the transverse and frontal (coronal) section specimens illustrated in Figures 6 to 9 aid in orienting one to the exact lateral to medial relationships of bones, muscles, arteries, nerves and eustachian tube. The crucial areas in each of the section specimens shown in Figures 6 and 7 are indicated as block inserts. Enlarged drawings of these inserts are shown in Figures 8 and 9.

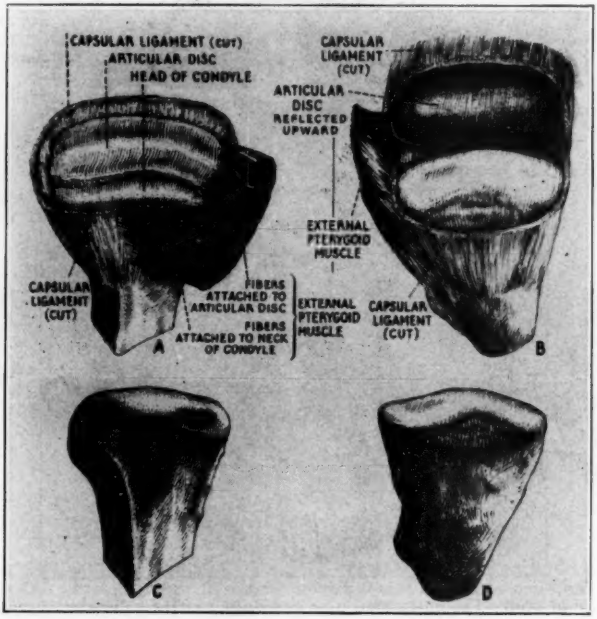

Fig. 3.—Drawings made from dissections of the human mandibular condyle. A and B, anterior and posterior views of soft tissues surrounding head of condyle. C and D, similar views of bony condyle after removal of soft tissues.

Pertinent structures shown in Figure 8 are the bony shelf (7 and 8, Fig. 8) which separates the head of the condyle anteriorly from the external auditory meatus, and the middle ear structures posteriorly; the exposed course of the chorda tympani nerve (3, Fig 8) lying medially from the condyle head as it leaves the skull through the petrotympanic fissure, and the area between the condyle and the bony cochlea (14, Fig. 8). The cochlea is not only far removed, but also well protected by bone from possible trauma from pressure by the condyle of the mandible. This coiled bony structure, diagrammatically enlarged in Figure 10, is lined by a membranous labyrinth housing the delicate receptors (hair cells of the organ of Corti) upon which the auditory nerve fibers form terminal arborizations.

Muscular pressure: Figure 9 better demonstrates the intervening soft structures in a frontal plane which passes posteriorly to the foramen ovale and anteriorly to the foramen spinosum

of the left side. Although the bony portions of the external meatus, the eustachian tube and the cochlea are amply protected from possible condylar pressure, one may observe here the exposed position of the cartilaginous eustachian tube as it leaves the skull (19, Fig. 9). As this segment of the tube approaches the nasopharynx, it becomes more and more intimately associated with the surrounding soft structures. (Fig. 2.)

this muscle, when contracting, may bulge medially and posteriorly along the superior head of the external pterygoid, affecting the cartilaginous tube through compression of the intervening soft structures, as suggested by Costen.[24] However, it must be remembered that such compression is the result of indirect passive muscular resistance rather than of a direct medial excursion of the head of the condyle.

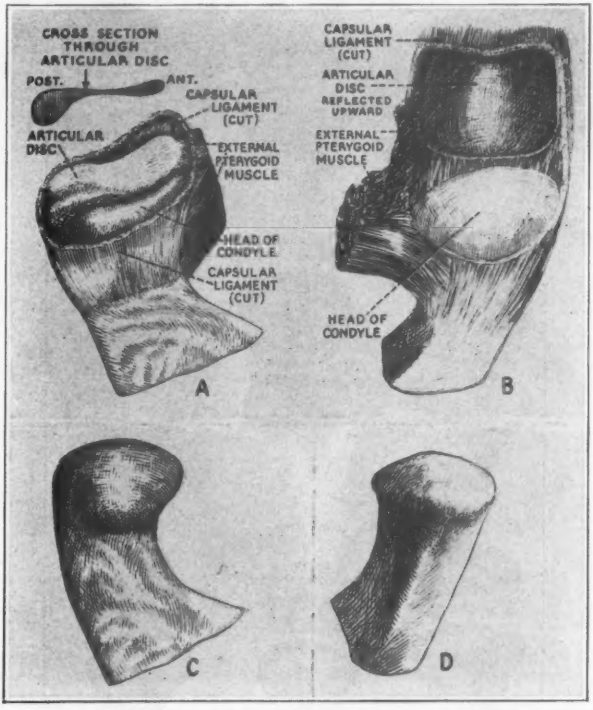

Fig. 4.—A and B, lateral and medial views of soft tissues surrounding head of mandibular condyle. C and D, similar views of bony condyle after removal of soft tissues.

If one mentally pictures the infratemporal fossa (indicated by X in Figure 2) in cases of marked overbite as being filled with the temporalis and the two heads of the external pterygoid muscles, it will be seen that the contraction distance of the internal pterygoid muscle is decreased and its action hampered. As a result,

The vertically directed mandibular nerve (6, Fig. 7), the internal maxillary artery (10, Fig. 9), the sphenomandibular ligament (18, Fig. 9) and the tensor and levator veli palatini muscles (2 and 17, Fig. 9) are the structures that would suffer displacement and compression against the tube. However, the actual

importance of each of these structures as compression factors, *if* they are displaced medially by the internal pterygoid and superior head of the external pterygoid muscles in overbite, is purely a matter of conjecture. There certainly exists an anatomic relationship between the tube and the adjacent muscles whereby a compression force can be exerted during overbite, but owing to the impossibility of examining each structure in these patients during life, one cannot be too dogmatic or positive.

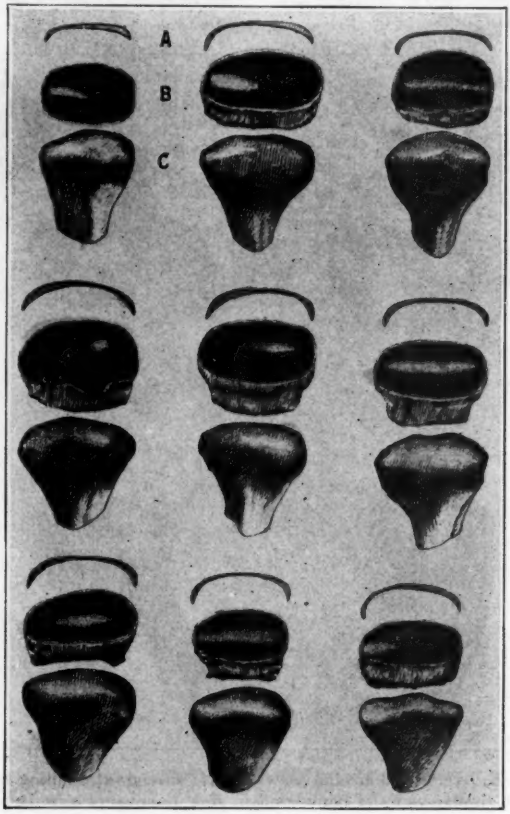

Fig. 5.—Condylar heads and articular disks drawn from dissection specimens from nine individuals. A, cross-section of articular disks. B, articular disk viewed from within; showing region of greatest wear (lightly shaded). C, head of mandibular condyle (posterior view).

Costen[29] concluded from his studies of a soft tissue specimen that overclosure of the jaw caused the tensor veli palatini and adjacent sphenomeniscus (superior head of the external pterygoid) muscles to wrinkle and crowd the eustachian tube, closing it firmly, and resulting in an inability of the tensor to open the tube during the act of deglutition, thus producing a derangement of intratympanic pressure and ensuing deafness. It is difficult to understand how any change in mandibular position can appreciably alter the pull of the tensor and levator veli palatini muscles, thus preventing

their action in opening the tube while tensing and elevating the soft palate simultaneously (2 and 3, Fig. 2). In view of the origins and insertions of these muscles, which are independent of the mandible, their respective actions, if altered, must be the result of pterygoid compression (Costen) or the inefficient action of their antagonistic muscles (Batson).

ent solely on the action of the tensor veli palatini muscle. Recognizing the exposed position of the tensor veli palatini muscle to passive pressure as it descends medially to the internal pterygoid muscle in the scaphoid fossa (1, Fig. 2), we attempted to study this region in a fresh postmortem specimen. In an unembalmed and edentulous male cadaver, we observed and palpated the tubal orifice into the

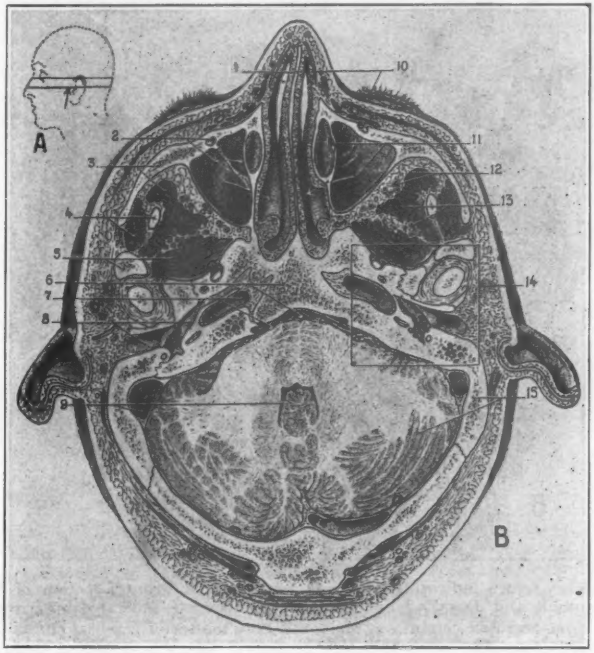

Fig. 6.—A, key-figure indicating plane of section B. B, cross-section of head through Reid's base line, looking upward into maxillary sinus and middle ear (tympanic) cavity, as indicated by direction of arrow in A. 1, atrium of middle nasal meatus and nasal septum. 2, infraorbital foramen enclosing artery and nerve, and multilocular maxillary sinus. 3, zygomatic bone and temporalis muscle. 4, masseter muscle and coronoid process of mandible. 5, articular tubercle (of squamous temporal bone) and external pterygoid muscle. 6, basisphenoid bone and basilar artery. 7, internal carotid artery and abducens nerve. 8, external auditory meatus and eustachian tube entering middle ear. 9, sigmoid portion of lateral sinus and fourth ventricle. 10, left lateral nasal cartilage and lower eyelid. 11, arrow in aperture of maxillary sinus and nasolacrimal duct. 12, anterior fibers of temporalis muscle and internal maxillary artery. 13, medial fibers of temporalis muscle and anterior and posterior deep temporal vessels. 14, superficial temporal vessels. 15, mastoid portion of temporal bone and cerebellum.

Rich[87] expressed the belief that the physiologic patency of the pharyngeal orifice of the eustachian tube is dependent

nasopharynx during manipulation of the mandible. In order to leave the crucial structures and face intact, the naso-

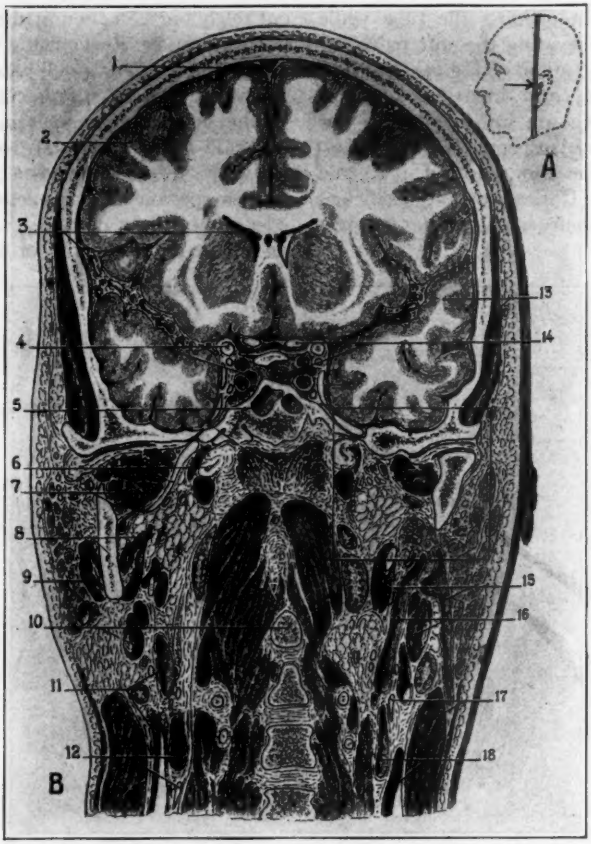

Fig. 7.—A, key-figure indicating plane of section B. B, frontal section of head through condyles of mandible and dorsal wall of nasopharynx. View is indicated by arrow in A. 1, superior sagittal sinus and falx cerebri. 2, scalp and gray matter of cerebral cortex of right parietal lobe. 3, rami of middle cerebral artery in lateral fissure and lateral ventricle of brain. 4, anterior clinoid process, and cavernous sinus containing internal carotid artery and cranial nerves III, IV, V (ophthalmic and maxillary divsions) and VI. 5, sphenoid sinus and lymphoid tissue of pharyngeal tonsil (adenoid). 6, mandibular nerve and eustachian tube. 7, superior fascicle of external pterygoid muscle (sphenomeniscus) and internal maxillary artery. 8, ramus of mandible and internal pterygoid muscle. 9, masseter muscle and posterior facial vein lying in parotid gland. 10, posterior belly of digastricus muscle and ventral border of the body of second cervical vertebra (axis). 11, right external carotid artery and internal jugular vein. 12, right internal carotid artery and vagus nerve. 13, left temporalis muscle and temporal lobe of cerebral hemisphere. 14, optic nerve (II) and anterior lobe of hypophysis. 15, styloid muscles attached to styloid process, and posterior facial vein. 16, digastricus muscle and external carotid artery. 17, sternocleidomastoid muscle and vagus nerve. 18, internal jugular vein and internal carotid artery.

pharyngeal roof was approached by removal of the calvarium, the brain and the body of the sphenoid bone. When the mandible was forcibly rotated to simulate masticatory movements, we were able to detect a slight medial deviation

of the cartilage of one eustachian tube, and also of the levator cushion as the mandible was forced to the opposite side. However, the most extreme pressure that we could exert failed to produce a medial tubal excursion of more than 2 mm. Whether such a deviation is greater in active contraction of the muscles of mastication during life we cannot say.

In working with this specimen, we were particularly impressed by the alternate tense and lax condition of the superior pharyngeal constrictor muscle as the mandible was moved from side to side. When it is recalled that this muscle is continuous with the buccinator through the pterygomandibular raphe, tenseness of the constrictor is readily understood as playing a secondary rôle to the pull of the buccinator during movements of the mandible. This and similar observations on the individual actions of the pharyn-

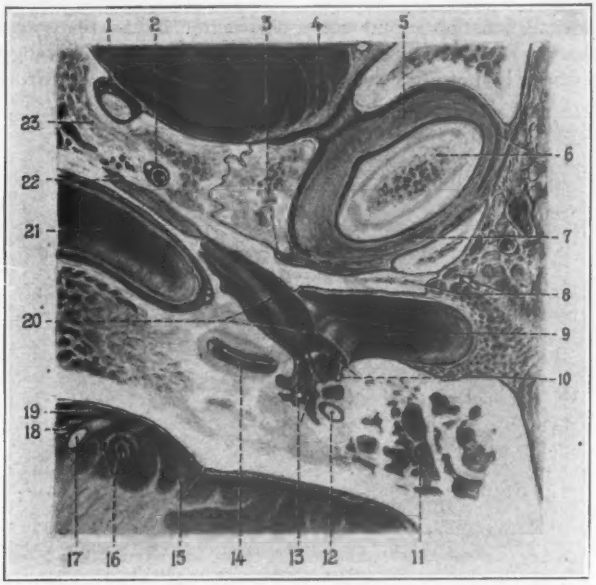

Fig. 8.—Higher magnification of region indicated in Figure 6, B, showing relationships of left temporomandibular joint and adjacent ear structures. 1, foramen ovale containing mandibular nerve, accessory meningeal artery and emissary vein. 2, foramen spinosum with middle meningeal artery and spinous (recurrent) nerve. 3, chorda tympani nerve leaving skull at medial end of petrotympanic fissure. 4, fibers of external pterygoid muscle inserted in capsular ligament. 5, articular tubercle and anterior margin of articular disk (meniscus). The apparent thickness of the disk is due to the obliquity of the section. 6, superior synovial cavity in region anteriorly from point of fusion of capsule and disk, and head of condyloid process of mandible. 7, postglenoid tubercle and thinned superior aspect of fibrocartilaginous disk. 8, auriculotemporal nerve and tympanic portion of temporal bone. 9, external auditory meatus and malleolar stria in tympanic membrane. 10, chorda tympani coursing forward in tympanic cavity after origin from facial nerve, and incus bone. 11, mastoid air cells. 12, facial nerve in facial canal. 13, middle ear cavity, tendon of stapedius muscle, and stapes bone. 14, bony cochlea in petrous portion of temporal bone. 15, gray matter of cerebellum and dura mater of posterior cranial fossa. 16, anterior inferior cerebellar artery and vein. 17, auditory (VIII) nerve. 18, facial nerve and nervus intermedius (of Wrisberg). 19, internal auditory artery. 20, eustachian tube entering tympanic cavity, and tendon of tensor tympani muscle. 21, internal carotid artery. 22, cartilage of eustachian tube. 23, greater wing of sphenoid bone.

geal constrictors, the veli palatini and faucial muscles, and other muscles of deglutition, tend to emphasize their complex and interrelated group action. Although we concur with Batson[25] that "whenever an improvement in hearing is found in closed bite cases after the opening of the bite, it is due to a restoration of the normal function to the salpingopalatopharyngeal kinetic chain of muscles," we would hesitate to attribute failure of the tubal opening in overbite cases to any single muscle or group of muscles. It cannot be denied that the tensor and levator veli palatini muscles normally play the dominant rôle in regulating tubal patency, but the accessory rôle of these adjacent groups of muscles in marked closure of the bite remains to us an indeterminate factor.

Pressure from nasopharyngeal lymphoid tissue or other obstructions: The obstruction of the pharyngeal orifice by hypertrophy of nasopharyngeal lymphoid tissue as described by Crowe *et al.*[58-60] has thrown new light upon the importance of the eustachian tube. Audiometer tests in such cases have shown a loss

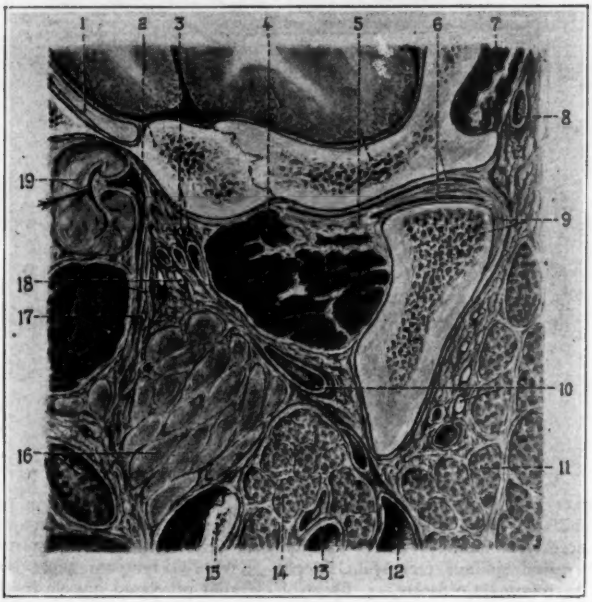

Fig. 9.—Higher magnification of region indicated in Figure 7, B; relationships of left temporomandibular joint and adjacent soft structures. 1, dura mater of middle cranial fossa and gasserian (semilunar) ganglion of trigeminal nerve. 2, greater wing of sphenoid bone and tensor veli palatini muscle. 3, middle meningeal artery and spinous (recurrent) nerve. 4, cortex of temporal lobe and external pterygoid muscle. 5, squamous temporal bone and tendinous continuity of external pterygoid with articular disk. 6, superior and inferior synovial cavities separated by articular disk. 7, temporalis muscle. 8, superficial temporal artery. 9, joint capsule and head of condyle. 10, rami of facial nerve and internal maxillary artery. 11 and 14, parotid gland. 12, posterior facial vein in parotid gland. 13, external carotid artery. 15, styloid process with attached muscles. 16, retropharyngeal lymph node and adjacent pad of adipose tissue. 17, levator veli palatini muscle and chorda tympani nerve. 18, sphenomandibular ligament and auriculotemporal nerve. 19, cartilage of eustachian tube and arrow inserted within lumen to indicate tubal direction.

of high tones, but return to normal hearing will follow x-ray treatment and the application of radium to the lymphoid tissue.

Symptoms of tubal obstruction have been further substantiated by the fascinating study of Loch[61] upon himself. This investigator noted the effects of simple tubal occlusion by inflating a soft rubber balloon in the nasopharynx and applying simultaneous repeated audiometric tests. His controlled experiments demonstrated that purely mechanical occlusion of the such passive pressure actually occurs, and the extent of tubal occlusion that it is capable of producing, are unknown. Before one attempts to remedy this unknown entity, it is first necessary to rule out the existence of more probable nasopharyngeal conditions of lymphoid hypertrophy, cysts or tumors or other nasopharyngeal abnormalities. The importance of the faucial and salpingopharyngeus muscles in preventing the normal action of the tensor and levator veli palatini muscles in opening the

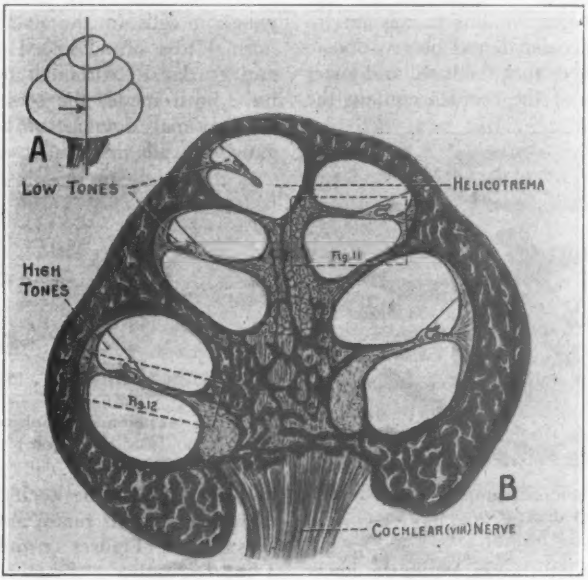

Fig. 10.—A, key-figure of bony cochlea with plane of section B. B, schematic representation of vertical section through middle of cochlea. Receptors for low tones are localized in the upper middle and apical coils of the membranous labyrinth, while those for high tones are found in the basal and lower middle turns. Rectangular inserts denote regions of photomicrographs shown in Figures 11 and 12.

tube caused first and primarily a hearing impairment in the high tone region, and later the hearing for middle and lower tones became slightly impaired.

Thus it is evident that an anatomic relationship exists whereby marked overbite may indirectly induce compression of the cartilaginous portion of the tube and reduce auditory acuity, but whether eustachian tube in cases of decreased intermaxillary vertical dimension remains a matter of individual interpretation and differences in individual patients.

CLINICAL AND EXPERIMENTAL OBSERVATIONS ON THE RÔLE OF AGE AS A CAUSE OF DEFECTIVE HEARING

That the third decade of life ushers

in a period of gradual loss of neurons and sensitivity,[40, 42, 62, 63] as well as a loss of teeth, is well known. The structural and clinical changes are so familiar, in fact, that their importance has become minimized or totally forgotten in such problems. In the literature pertaining to the present study, the changes that occur in the auditory nerve with age have been classed as merely incidental, and have been omitted. If one realizes that most patients with overbite and loss of high tones fall into a group in which such ear symptoms are to be expected, the age factor no longer remains merely an interesting and coincidental observation.

The discovery that the basal and lower middle turns of the cochlea contain the

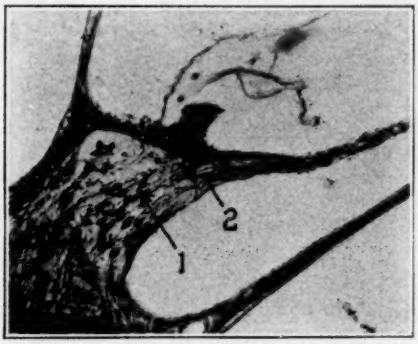

Fig. 11.—Photomicrograph of upper turn of rat cochlea. (Bodian; ×400.)

receptors for high tones, while the lower tones are localized in the more apical turns,[38, 64] is particularly important. This localization is diagrammatically indicated in Figure 10. Further studies[38, 39] show an interesting relation between antemortem clinical demonstration of loss of high tones as determined by audiometric tests in a number of human cases and as later verified by morphologic examination of the cochlea of the same individuals after death. The deviation from the normal structure of the cochlea most commonly observed is an atrophy of the spiral ganglion cells and nerve fibers in the lower half of the basal turn. Such atrophy may or may not be accompanied by degenerative changes in the organ of Corti. This loss of nerve cells and their fibers from the crucial basal turn of the cochlea with age constitutes a neural lesion with impairment of hearing for high tones. This age factor does not appear to be the result of any one of the five most common systemic diseases: arteriosclerosis, syphilis, hypertension, chronic cardiovascular-renal disease and malignant growths.[65]

We have observed a similar loss of ganglion cells in the cochlea of three normal rats of advanced age (2 years and 10 days). Although no cell counts have been made, the serial sections of these animals demonstrate an absence of ganglion cells in the basal and lower

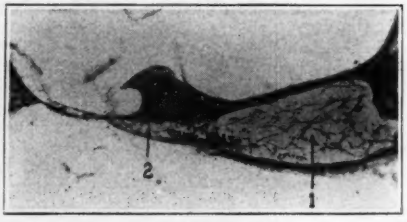

Fig. 12.—Photomicrograph of basal turn of rat cochlea. (Bodian; ×400.)

middle turns of the cochlea, while the more apical turns retain abundant numbers of cells. Figures 11 and 12 are from a representative section of the cochlea. The regions shown in these figures, indicated as block inserts in Figure 10, demonstrate structural alterations similar to those already described in man.[38, 39]

The apical turn shows an abundant number of bipolar ganglion cells (1, Fig. 11) with their stained peripheral processes (2, Fig. 11) extending through the osseous lamina spiralis to reach the hair cells of the organ of Corti. In contrast, the basal turn has few or no ganglion cells (1, Fig. 12) and a noticeable absence of their fibers in the bony lamina (2, Fig. 12).

Microscopic examination of the retained ganglion cells in these animals does not reveal any cytologic changes, such as one finds in the somatic sensory neurons of man and animals,[40, 42] to indicate the nature of the destructive process. Such studies of the life history (cytomorphosis) of the nerve cells from the neuroblast stage to senile neurons are far from completion, many problems remaining unanswered. However, they serve to emphasize the need for better functional data and correlated histologic preparations in a great number of cases, before our final conclusions can be based on known truths.

Thus age is one of the primary factors to be considered in cases wherein high tones are involved; for if the nerve cells of the spiral ganglion or the cells of the organ of Corti are lost along with bone conduction, no mechanical or surgical intervention can replace the nervous elements.

DO CONTROLLED AUDIOMETRIC TESTS CONFIRM THE ALLEGED IMPROVEMENT IN HEARING FOLLOWING AN INCREASE IN THE INTERMAXILLARY VERTICAL DIMENSION?

Audiometric tests have long been recognized as the only accurate means of answering the question as to whether the alleged improvement in hearing follows an increase in the intermaxillary vertical dimension. Harris[66] believed that he was able to demonstrate a marked improvement in hearing following the construction of new dentures and checked by means of audiograms. This study has been justifiably criticized by Junemann,[15] since the audiograms simply tested speech, and were also insufficient in number.

The extensive studies of Junemann,[15] which were directed toward answering the vital questions of this specific problem, provide the only concrete audiometric evidence that we have to date. His negative results in forty-nine patients do not substantiate the belief that an increase in the intermaxillary vertical dimension improves hearing ability, although such procedure in many cases has been shown to relieve tinnitus and pain in the temporal, parietal and masseteric regions.

In the light of our present knowledge, based solely on one controlled audiometric series of cases,[15] we admittedly possess insufficient data to warrant extensive or positive conclusions. On the contrary, the evidence thus far points toward the fallacy of a number of bold statements found in the literature, such as "repositioning of the jaw will relieve deafness." Although such procedure may relieve "stuffiness in the ears," joint pains, dizziness and similar complaints, these should be differentiated from actual impairment or loss of hearing. This reflects the opinion expressed in the recent dental and otologic studies of Babbitt,[23] Chor,[18] Crowe and Guild,[58] Fowler[26] and Junemann.[15]

III. SUMMARY AND CONCLUSIONS

1. Erosion of the bony portions of the temporomandibular joint or of the articular disk has no effect on hearing.

2. Occlusion of the external auditory meatus by the mandibular condyle, or any influence that the condyle may exert upon the middle ear or cochlea, is a negligible factor in auditory impairment.

3. Muscular compression of the eustachian tube by intervening soft structures through existing anatomic relationships may possibly affect the hearing, but the degree of tubal compression or its actual occlusion remains speculative.

4. Diagnostic roentgenographic interpretations of changes occurring within the temporomandibular joint cavity are unreliable because of anatomic considerations and technical limitations.

5. It is morphologically possible that there exist intrinsic reflexes involving solely the sensory and motor fibers of the trigeminal or the facial nerves which

may induce tonic spasm of the respective tensor tympani and stapedius muscles. Such reflexes, however, have not been demonstrated in the edentulous patient or in cases of temporomandibular joint disturbance. Reflex contraction of either of these muscles results in a loss of ability to hear low tones, including those frequencies for spoken words, as contrasted with a loss of higher tones accompanying advancing age and tubal obstruction. Recent studies in controlled experiments do not substantiate the current belief that an increase in the intermaxillary vertical dimension will improve auditory acuity for high tones. It must be remembered that these cases usually fall into an age group where such symptoms are to be expected, and careful audiometric tests are required in differentiating between the middle age loss of nervous elements and tubal obstruction. Age must be considered where high tones are involved; for, if the nerve cells of the spiral ganglion or the cells of the organ of Corti are lost, along with bone conduction, no mechanical or surgical intervention can replace the nervous elements.

Similarly, it is necessary, before attempting to open the bite, to rule out, by a thorough nasopharyngeal examination, structures that may occlude the orifice of the eustachian tube. The appropriate words of Hill[67] most adequately express our opinions:

> There is a sort of self-hypnotism among deafened people, who, above all, desire to hear better, which causes them to feel improved temporarily under any new form of treatment. This imagined improvement plus the natural enthusiasm of the discoverer of the treatment, sometimes leads to unwarranted claims for its efficacy, and it may have rather widespread use until the careful observations of impartial investigators prove its ineffectiveness.

6. A differential diagnosis of the type of hearing impairment, by means of proper electro-audiometric tests, is essential before attempting therapeutic measures. If tests indicate, in cases of a reduction in the intermaxillary vertical dimension, that deafness is of the obstructive type, as described above, the dentist may, in these cases, hope to attain success in relieving the condition by opening the bite.

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MANIPULATION OF AMALGAM

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INTRODUCTION

THE selection of a filling material for the tooth at hand is a matter of judgment. Before judgment can be passed on any filling material, a thorough knowledge of its physical, chemical and mechanical properties is imperative. For a given filling material of definite physical, chemical and mechanical properties, a cavity preparation incorporating mechanical principles must be evolved which places the filling material at an advantage for the greatest utilization of its properties. This consideration is still fundamental in the amalgam restoration.

The term "amalgam failure" is a malapropism. What is meant by amalgam failure? Does the amalgam fail? Does the cavity fail? Or is the cavity so lacking in mechanical principles that the amalgam filling material is placed in an environment at an extreme disadvantage to its physical, chemical and mechanical properties?

It is not improbable that the physical and chemical properties of amalgam in

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the future may be so enhanced that the limitations of cavity preparations will be modified with regard to the factor of mechanical manipulation. The revived interest in the condensing of the plastic amalgam filling material is justification for this statement.

MATRICES

The condensing of the plastic amalgam filling material into compound cavities necessitates the use of matrix. The use of a matrix has opened a prodigious field of endeavor for the inventive dentist.

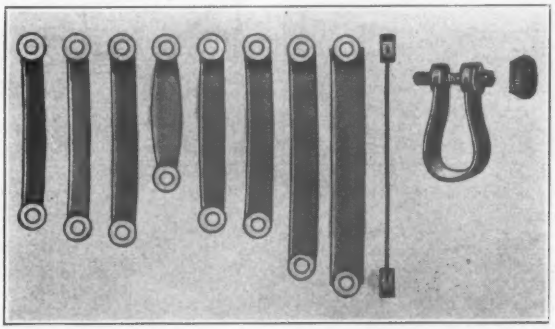


Fig. 1.—The loop matrix. (Kirk.)

Fig. 2—The Miller clamp matrix. (Kirk.)

The original matrix for a compound cavity was nothing more than a piece of metal band wedged securely between the teeth. This matrix was fixed against the tooth to be filled with a wedge of wood previously dipped in sandarac. It was soon recognized that this type of matrix sacrificed contact and contour. Jack[1] prepared a band in assorted sizes with contours which were secured by packing between it and the adjacent tooth some oxyphosphate of zinc cement. The wedged band matrix soon led to the use of the ligated matrix, which is prepared so that, when placed on the tooth, it can be drawn up securely by means of a ligature about the gingival third of the tooth. A wedge is used with the ligated matrix as additional protection against spreading from the gingival margin and for separation.

The search for a matrix which could be adapted securely and quickly culminated in many types of mechanical matrices. The loop matrix (Fig. 1) is an example of one of the first mechanical matrices. The disadvantage to this type of mechanical matrix is that contact and contour are lost as the band is drawn securely about the tooth. This same disadvantage is encountered in many matrices of the clamp band type.

One of the first mechanical matrices to effect separation for a compound cavity was the Miller matrix. (Fig. 2.) This type of matrix, when slipped between the teeth, is not very flexible and adaptation to the cavosurface angles of the cavity is difficult. However, it does effect separation. It is interesting to note that recently Munch[2] advocated the use of a rubber "adapto" matrix. This rubber matrix gives the necessary separation, the same as the Miller. However, the elasticity of the proximal portion is

a factor to be contended with in condensing the amalgam.

For many years, the profession has used the Ivory matrix clamp and band with success. This matrix holder adapts the band securely at the gingival third. Some separation is obtained by use of a wedge, and the prepared band can be burnished to contour and contact with the adjacent tooth.

The idea of a screw wedge matrix,

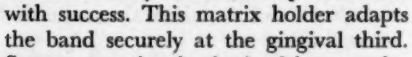


Fig. 3.—Ivory matrix in use, from buccal and occlusal aspects.

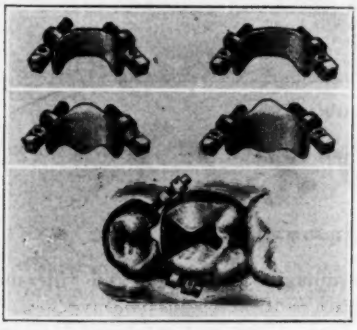


Fig. 4.—Woodward's screw matrix. (Kirk.)

which is not new, owes its precedence to the operators of gold foil. Figure 4 is an illustration of the Woodward matrix, which employs two screws for separation as well as retention of the matrix band. The rigidity with which this device is constructed inhibits its adaptability. This disadvantage can be eliminated by the use of a piece of stainless steel banding material 0.002 inch in thickness in conjunction with a mechanical separator.[4] (Fig. 5.) The Perry, the Ferrier and the Walls separators lend themselves very nicely to this type of adaptation.

The Harper matrix holder (Fig. 6, A) is another example of the screw wedge type. It is adapted as illustrated in Figure 6, B and C.

This screw wedge matrix holder depends for its effectiveness on two wedge-shaped prongs that hold the band firmly against the tooth at the gingival margin.

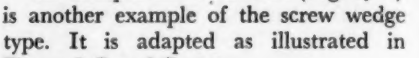


Fig. 5.—Mechanical separator as matrix band holder. (After Black.)

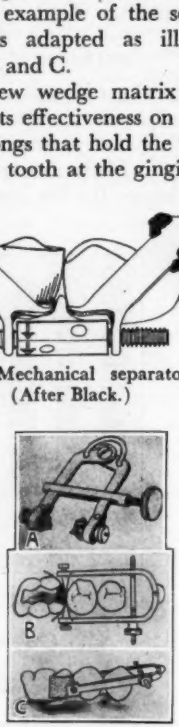


Fig. 6.—A, Harper matrix holder. B, occlusal aspect, in use. C, buccal aspect, in use.

Therefore, it acts as a mechanical separator and is a matrix holder at the same time.

Today, the demand for a high-ridged matrix has been increased because of the use of the mechanical condensors. Sweeney[5] suggests a matrix incorporating features both old and new. An untempered piece of banding material is fitted and contoured and is held in position by means of a wedge, which also effects separation. This wedged band is rein-

forced with modeling compound and the jaws of a number one ivory retainer are warmed and pressed into the compound reinforcements.

Thus, we see that the original wedged band matrix has been revitalized by means of a mechanical matrix and a reinforcing material. However, for practical purposes, there are many splendid mechanical matrix retainers which (1) are easily applied and fixed in position, (2) separate the teeth sufficiently to compensate the contact for the thickness of the banding material, (3) can be adapted and properly contoured, (4) may be reinforced by means of modeling compound, cement or plaster if the operator so desires and (5) are easily removed.

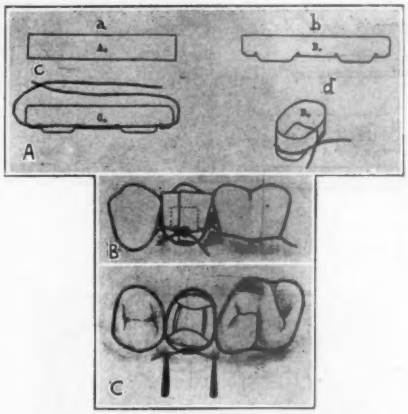


Fig. 7.—Ligated matrix. A, steps in preparation of band. B, occlusal and buccal aspects of matrix in position. (After McGehee and Black.)

The mechanical matrix retainer for the complex cavities of the mesioclusodistal type has not reached the point of development that one would expect. Because of the limitations of the matrix retainer, the advisability of preparing a complex cavity for filling with amalgam is questionable.

In the past, both the continuous band matrix and the ligated matrix were used. Occasionally, a complex cavity is seen in which the continuous band matrix or the ligated matrix is the only type that will permit filling of the cavity. (Fig. 7.)

The band is prepared as illustrated in steps A, B, C and D. Slots have been made in the band to prevent the ligature from slipping and wooden wedges have been inserted to hold the band tightly over the gingival margin and to separate the teeth. The continuous band matrix (Fig. 8) is valuable for badly broken down teeth requiring extensive restoration. It is held in position by means of small wedges on the mesial and distal sides. Although the wedges effect some separation, contact is usually lost. A properly fitted continuous matrix need not be removed until the amalgam has set thoroughly.

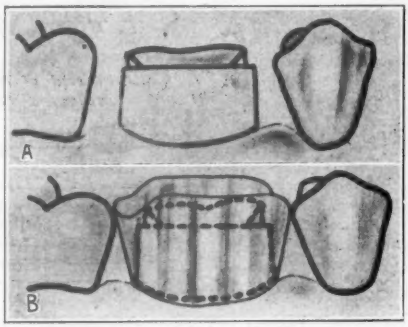


Fig. 8.—Continuous band matrix.

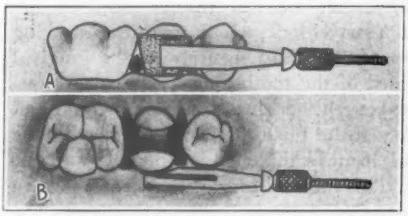


Fig. 9.—Wagner mechanical continuous band matrix holder.

It is in dealing with complex cavities that the Wagner continuous band matrix holder finds its most frequent use. (Fig. 9.) The disadvantage of this type of

matrix holder is that, as the band is drawn up tightly, contact with the adjacent teeth is lost.

Recently this disadvantage has been minimized by the development of the Siqveland matrix.

The adaptation of this matrix is illustrated in Figure 10, B. The principal advantage of this matrix retainer lies in a swivel lock, which permits a drawing up of the band securely at the gingival third of the tooth and, at the same time, leaves the occlusal third of the band free to be burnished to contact with the adjacent teeth.

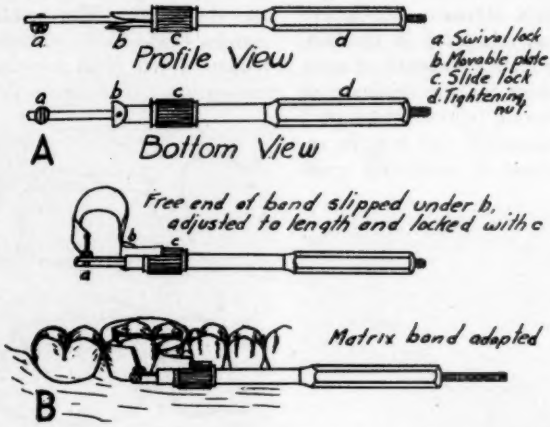


Fig. 10.—A, Siqveland continuous band matrix. B, adaptation and use.

This brief history of matrices has been introduced to show the ingenuity of the dental profession in its search for a "perfect universal" matrix retainer and holder. Not only do the compound and complex cavities require matrices: occasionally, a simple buccal cavity is so large that it requires a matrix. We are indebted to J. M. Prime[6] for the matrix illustrated in Figure 11 for large buccal cavities. A copperband in which has been placed a window somewhat smaller than the buccal cavity is slipped over the tooth. The amalgam is packed through this window. This is but one of the many temporary types of matrices that have been suggested from time to time by various practitioners.

Each cavity presents a problem for applying the matrix, and in spite of the wide selection of mechanical retainers, there occasionally is seen a case in which the matrix cannot be used.

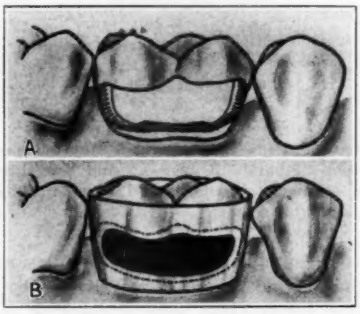


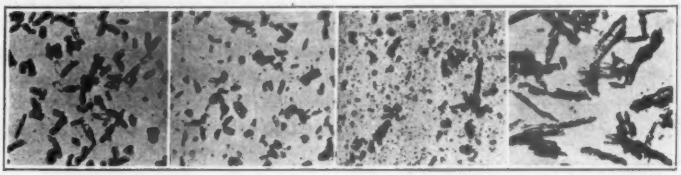
Fig. 11.—Matrix for large buccal cavities. (After Hollenbeck.)

CHARACTERISTICS OF AMALGAM

The physical and chemical properties of amalgam are under the constant surveillance of the Bureau of Standards in Washington, D. C. The Bureau has published a list of certified alloys on the market today, varying as to composition,

particle size and setting time. The manufacturers indicate the mercury : alloy ratio which produces an amalgam meeting the requirements of the Bureau of Standards. This mercury : alloy ratio is different for the various types of alloy. their product. If a dispenser is not used, the mercury and alloy should be weighed out to the proportion suggested by the manufacturer. This is the procedure followed at the University of Minnesota.

The mechanical preparation of an



A B C D

Fig. 12.—Effect of dry trituration. A, comminuted alloy before trituration. B, same alloy after trituration. C, coarse-cut alloy before trituration. D, same alloy after trituration for one minute. (After Coy and Liebig.)

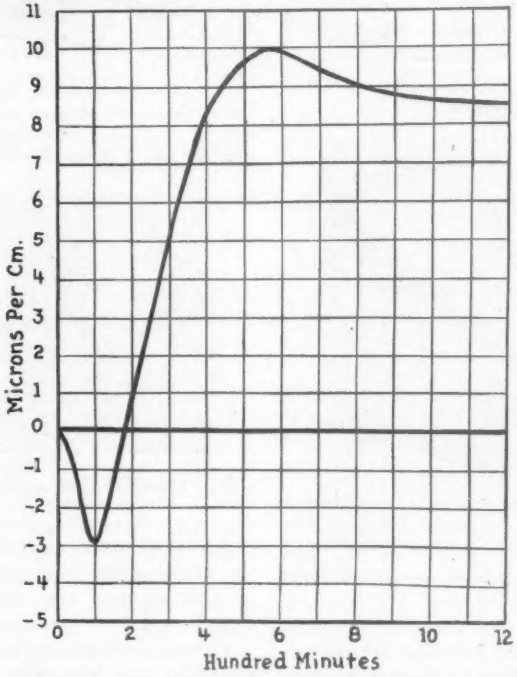


Fig. 13.—Schematic curve of contraction-expansion phenomena of amalgam.

Therefore, this ratio should be studied and adhered to before an amalgamation.

Many manufacturers prepare dispensing devices that are calibrated to give the correct mercury : alloy ratio for amalgam for a filling is subject to a biologic element known as individual differences. A great deal has been written on the variability of trituration. The trend today is toward automatically

timed mechanical trituration. These controllable mechanical amalgators are time-saving devices for the dentist; but it is still a question whether the range of variation which occurs in the laboratory tests on trituration is within the limits of probable effectiveness in a practical case. At the University of Minnesota, School of Dentistry, the mortar and pestle are used for trituration.

AMALGAM	BREAKING LOAD IN POUNDS	COMPRESSIVE STRENGTH LBS. PER SQ. INCH
A. SLOPPY MIX, HIGH SILVER ALLOY, NO MERCURY EXPRESSED IN PACKING	700	15,900
B. ALLOY HG RATIO 1:1, PACKED HARD, EXCESS HG REMOVED DURING PACKING	1445	32,950
C. SLOPPY MIX, EXPRESSED HG EXCESS, PACKED HARD WITH PNEUMATIC CONDENSER #4	1460	33,200
D. ALLOY HG RATIO 1:0.5, EXCESS HG EXPRESSED, PACKED WITH PNEUMATIC CONDENSER #4	1260	28,750
E. ALLOY HG RATIO 1:1, PACKED BY HAND PRESSURE BY A STUDENT	1700	38,800
F. SLOPPY MIX, OWRE'S ALLOY, PACKED HARD WITH A PNEUMATIC CONDENSER #4	1850	43,000

Fig. 14.—Results of experiment on amalgam compressive strength.

Fig. 15.—Excess mercury expressed by finger pressure.

There have been many hypotheses advanced to explain the influence of variations in the size and shape of the initial alloy particles upon the properties of amalgam during trituration; but we can be reasonably sure that the comminuted alloys are the least affected during trituration, while the non-comminuted alloys or coarse shavings are broken up into a heterogeneous mass of large and small particles and dust.

Coy and Liebig[7] have demonstrated this clearly by means of photomicrographs. (Fig. 12.) It is to be emphasized that, in these illustrations, the trituration was carried out without mercury being present, and, while the mercury acts as a lubricant, the experiment gives some idea as to the effect of trituration on particle size of the comminuted and non-comminuted alloys.

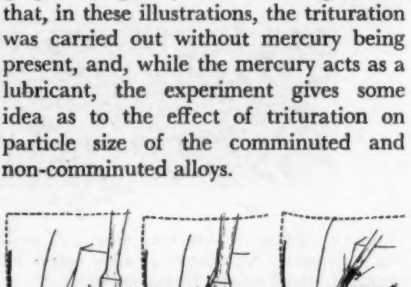


Fig. 16.—A, amalgam condensed directly below thrust of plugger point. B, plugger stepped laterally, wedging amalgam. C, smaller plugger for condensing retention form.

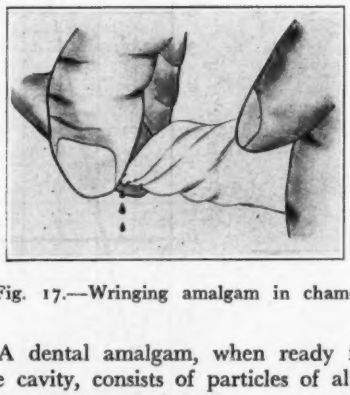


Fig. 17.—Wringing amalgam in chamois.

A dental amalgam, when ready for the cavity, consists of particles of alloy in a solution of the alloys, component metals and free excess mercury.

Cannon[8] has demonstrated that coarse grained filings trap mercury, which it is very difficult to remove during condensation; whereas a comminuted alloy is more completely enveloped in mercury and the alloy particles are brought closer together during condensation. Prolonged trituration of coarse grained filings does

not produce a fully comminuted alloy, and the carved surface of a fine grain comminuted alloy is easily distinguished from the carved surface of a coarse-grain non-comminuted alloy by even the most inexperienced operator.

Thus, it becomes apparent that the length of time for trituration of amalgam is dependent on the composition and purity of constituents, the alloy : mercury ratio and particle size of the alloy, all factors that can be controlled. Nevertheless, there are other factors in trituration time. For example, the hand pressure that each individual operator exerts upon the pestle in the mortar is subject to individual differences. Likewise, the shape and condition of the mortar and pestle are factors which affect the length of time necessary to amalgamate the alloy with mercury.[9] One can rightly question the significance of these uncontrollable factors when compared to the "aging" of the alloy.

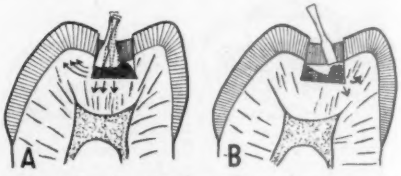


Fig. 18.—A, stepping of amalgam on occlusal pulpal wall. B, wedging of amalgam between axial walls.

All alloys oxidize upon exposure to air. The degree to which an alloy has oxidized in the average dental office is a moot question. This effect is not only exerted on trituration time, but also setting time of the amalgam. Many manufacturers of alloys anneal their products to control setting time. While the annealing actually rearranges the molecular structure of the alloy, it also oxidizes the alloy. However, after the alloy leaves the manufacturer, it undergoes further oxidation, and dentists have very little control over this process. It has been suggested that the purchase of a smaller quantity of alloy and at more frequent intervals is good practice.

In the light of this discussion, it is possible to define trituration as a mechanical process which abrades the particles of alloy so that the non-oxidized surfaces may react with an exudation of mercury. As a matter of fact, it is possible to produce a chemical amalgamation by adding various acids to a mix of alloy and mercury. However, for dental restorations, this technic is not recommended. Dental alloys, when amalgamated, have an inherent tendency to contract and expand during the process of setting. The Bureau of Standards has prescribed that within twenty-four hours after amalgamation the length (1 cm.) shall have increased between 3 and 13 microns per cm. Various types of curves are produced by manipulation of the alloy and mercury during trituration and condensation. On the basis of these curves, the Bureau of Standards has arrived at the percentage composition of the alloys approved today. For example, from the high tin content alloys is produced a contracting amalgam. By increasing the silver content, the Bureau of Standards has attempted to give to the profession a balanced alloy that has practically neutral contraction and expansion properties. In spite of the fact that the profession has a balanced alloy, it is possible to manipulate an amalgam and influence its contraction-expansion properties. Because of these extrinsic influences, many fine operators have set forth rules of manipulation with

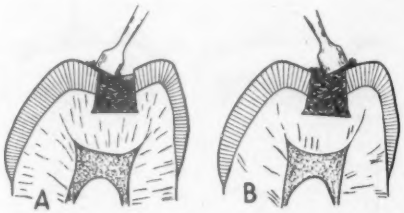


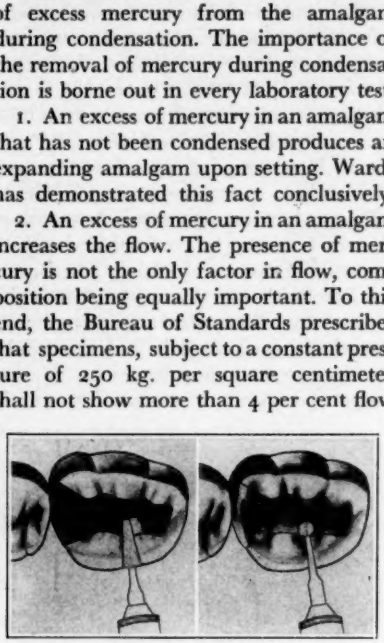
Fig. 19.—A and B, overfilling cavity with dry amalgam.

the view of standardizing amalgam technic.

The underlying principle of all these "standardized technics" is the removal of excess mercury from the amalgam during condensation. The importance of the removal of mercury during condensation is borne out in every laboratory test.

1. An excess of mercury in an amalgam that has not been condensed produces an expanding amalgam upon setting. Ward[9] has demonstrated this fact conclusively.

2. An excess of mercury in an amalgam increases the flow. The presence of mercury is not the only factor in flow, composition being equally important. To this end, the Bureau of Standards prescribes that specimens, subject to a constant pressure of 250 kg. per square centimeter shall not show more than 4 per cent flow in a period of twenty-four hours. Skinner,[10] in discussing the approved balanced alloy, states that "as far as the property of flow is concerned, the pressure of condensation is not as great a factor as has been supposed, but light condensing thrusts are not indicated because of the danger of overexpansion." It is the excess mercury that causes the overexpansion.



A B

Fig. 20.—A, removing overhanging amalgam. B, emphasizing form.

3. An excess of mercury in an amalgam affects the crushing strength of the amalgam.

A test for crushing strength of amalgam is not practical. However, an experiment on compressive strength of amalgam was conducted at the University of Minnesota by George L. Lundberg, and Ralph Dowdell. The results (Fig. 14) are offered only as proof of the importance of removing excess mercury during condensation. It is interesting to note that the greatest compressive strength was obtained from Owre's alloy, which is used as a die material at the University of Minnesota.

The work of Jarabak[11] again indicates the importance of particle size in the condensation of amalgam. He states that expansion decreases as particles become smaller. It is an obvious mechanical principle that graded particles of a comminuted alloy can be condensed into a dense structure with a minimum amount of mercury in the interstices.

An amalgam hardens by virtue of the fact that the mercury diffuses from the interstices into the alloy. As some of this diffusion takes place during trituration, the factors of particle size and oxidation of the alloy have a direct bearing on the length of time required for the amalgam to harden. If, after trituration, the packing is delayed, a greater amount of mercury will diffuse into the alloy; regardless of the amount of condensation, a greater amount of mercury is in the alloy, the result being an expanding, flowing, weaker amalgam.

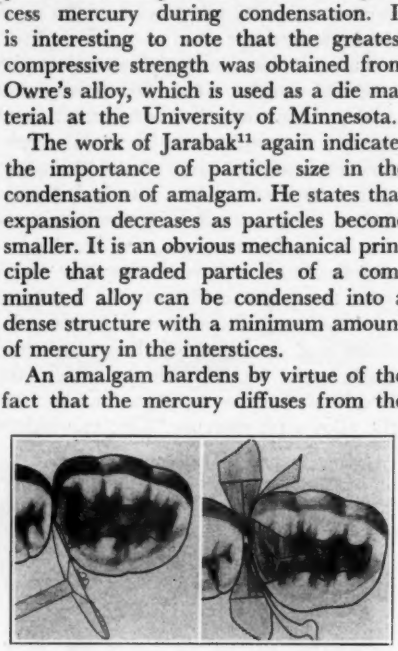


Fig. 21.—A, use of a cuttle disk on proximal margins. B, contouring filling with strips.

Our profession is deeply indebted to the men of science who have devised the "balance alloy." Little do we realize what a delicate balance this is and how important it is to control and minimize conditions that may upset this balance.

However, the control of these conditions can be simmered down to a problem of manipulation of the amalgam after correct trituration. Condensation remains the variable with which each individual has to cope. In the effort to control the variable of condensation, the majority of men agree that the removal of mercury from the plastic amalgam is of paramount importance.

Every operator has a technic whereby he believes that he is condensing the amalgam to a point rendering the amalgam filling successful In a teaching institution, it is very important that the neophyte dentist be given a practical technic by which he can express free mercury from the amalgam during condensation. At the University of Minnesota, the following technic is advocated:

1. After trituration of the alloy and mercury to a smooth plastic mass, the amalgam is removed from the mortar and the excess mercury is expressed from the mass by means of finger pressure. (Fig. 15.) "Mulling" of the amalgam as it is conventionally understood is not advocated, because of moisture contamination from the palm of the hand.

2. After cleaning and drying the cavity, a small portion of this plastic amalgam is carried into the deepest portion of the cavity on a plugger and forced against the walls. Figure 16, A illustrates this initial step in the gingival seat of a compound cavity. For illustrative purposes, the matrix in the dotted line is considered transparent.

The amalgam is condensed directly below the thrust of the plugger point, but the excess amalgam is forced laterally at the gingival seat. Therefore, the plugger point should be "stepped" laterally, wedging the amalgam securely between the matrix and the proximal axial walls. (Fig. 16, B.)

The lateral wedging of amalgam into a cavity is not considered sufficient to condense the amalgam in the retention forms. Therefore, small pluggers which can be adapted to the retention forms are selected for this purpose. (Fig. 16, C.)

3. As the amalgam is progressively condensed to the occlusal pulpal wall, the excess mercury accumulates on the surface. This "slush" is removed and, at this point, a drier amalgam is introduced, being prepared by wringing in a piece of chamois. (Fig. 17.)

4. The occlusal portion of the cavity is packed in the same manner as the proximal portion. Figure 18, A illustrates the stepping of the amalgam on the occlusal pulpal wall. Figure 18, B illustrates the wedging of the amalgam between the axial walls.

5. Figures 19, A and 19, B illustrate the overfilling of the cavity with amalgam. Dry amalgam is added as excess over the cavo-surface angles. "After-condensation" is obtained by using a larger plugger and the hand mallet, although points are available for "after-condensation" with the electropneumatic condensor.

6. After the initial set, the matrix is removed and carving instituted. Particular attention is given to the margin at the gingival area because many of the posterior teeth present a concavity on the proximal surface that cannot be removed with strips. Shallow carving of the occlusal surface is advocated in so far as it does not interfere with occlusion.

7. The amalgam filling is not polished until at least twenty-four hours after insertion.

FINISHING AND POLISHING

At the University of Minnesota, a few simple steps are followed in the finishing and polishing of the amalgam filling:

1. The occlusal surface is stoned down so that there is no overhanging amalgam at the cavo-surface angle. (Fig. 20, A.)

2. The anatomic form of the filling is emphasized by means of round finishing burs. (Fig. 20, B.) The entire occlusal surface can be smoothed by means of

other conveniently shaped finishing burs. Discretion must be used in working amalgam with stones and burs not to overheat the amalgam. Overheating is not only uncomfortable for the patient, but also affects the physical properties of the amalgam.

3. As much of the proximal surface is finished as can be reached by cuttle disks. (Fig. 21, A.) Because these disks have a tendency to create a broad projecting contact point, it is necessary to separate the proximal surface and use linen finishing strips. (Fig. 21, B.) These strips do not remove an appreciable amount of the contact point, but they do develop the proper contour for the filling. The strip is also used to polish the proximal surface.

4. The finished amalgam filling is polished by means of pumice and whiting conveyed on small brushwheels and rubber cup polishers. A high luster is obtained by polishing with a paste of tin oxide and alcohol in a rubber cup. As the alcohol evaporates, the dry tin oxide brings out the luster.

CONCLUSION

The technic by which the alloy and mercury are manipulated during trituration and condensation has a direct bearing on the ultimate physical, chemical and mechanical properties of the filling. However, it has been observed clinically that the factor of manipulation during trituration and condensation cannot be modified so as to compensate for the limitations of an amalgam cavity preparation.

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PHYSICAL AND CLINICAL CHARACTERISTICS OF SYNTHETIC RESINS USED IN DENTISTRY

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IT is now a little more than five years since Dr. Walter Wright first presented the results of his studies on acrylic resins to the National Society of Denture Prosthetists at Atlantic City in July 1937.[1] It is also approximately five years since Vernonite was offered to the profession as the first successful American made acrylic denture resin. About the same time, Crystolex was also made available for use as a denture resin. During this five-year period much time has been devoted to the study of properties of the acrylic resins by investigators working in laboratories of dental schools, the Bureau of Standards and well equipped manufacturers; many thousands of practical full and partial denture cases have been prepared from these resins by a variety of technics; and numerous other acrylic resin compounds have appeared on the market to compete with the original products.

More recently the acrylic resins have been adapted to use in inlay, crown and bridge prosthesis. The use of resins for this purpose was first reported in June 1940 by Harris[2] and Wilson.[3] The American profession therefore has known about acrylic resins and used them for this purpose for only a little more than two and one-half years. In continental Europe they have been used for a slightly longer time.[4] Many contradictory viewpoints have been expressed by research investigators and practitioners during this brief period regarding the merits of the resins for tooth restoration purposes. Several products have appeared on the market with a variety of processing technics to be used, and some studies have been reported of the comparative properties of the resins designed for this type of prosthesis.[5, 6]

When the acrylic resins were first introduced for denture purposes, it was generally agreed that the answer regarding their successful use or ultimate failure could not be given until the profession had used them in practical cases for at least a five year period.[7] That time has now elapsed and it seems that the predictions were about correct. The desirable qualities, as well as the shortcomings, of these resins are now quite well established, as they apply to full and partial denture prosthesis. Their use for tooth restoration purposes is, however, not so well defined. An additional period of two or three years is needed to determine the true value of resins for this use.

It is generally thought by those in dental practice that from a biologic and functional standpoint a full or partial denture is due for rehabilitation after a five year period of use. To render proper patient health service, a denture should be checked and corrected for any tissue adjustments that may have occurred during that time. There is, therefore, the question of possible tissue adjustments that must be considered in the use of resins for denture prosthesis. This factor is missing when the resins are used for tooth restoration purposes. Accordingly different physical characteristics are desired and likewise different "life" values are anticipated from the two types of restorations.

Read at the Annual Midwinter Meeting of Chicago Dental Society, February 24, 1943.

MATERIALS

Methyl Methacrylate.—The composition of the majority of denture and tooth restorative resins on the market is primarily some form of methyl methacrylate. It has been shown by tests that fundamentally there is no difference between the materials used for denture purposes and those used for tooth restorative structures, except for minor variations.[6]

The chemical nature and general properties of this substance are quite well established, having been studied and discussed by numerous investigators.[8, 9, 10, 11] It is common knowledge that pure methyl methacrylate in the monomeric form is a colorless liquid of low viscosity and low specific gravity (0.95 grams per cubic centimeter) which is ordinarily obtained by synthesis from petroleum, as a derivative of ethylene gas, coal or natural gas.[12, 13, 14] The starting material may be propylene, which when combined with other substances, as water, air, sodium cyanide, and methyl alcohol under carefully controlled conditions yields the methyl methacrylate monomer. A wide variation of methods now have been reported for the preparation of this material and the one actually employed may depend on the cost and ready access to raw materials.

The monomer has a boiling point of 100.3°C. (212.5°F.), but is reasonably stable below 65°C. (149°F.). This liquid monomer may be converted to a transparent solid through polymerization, which is aided by the presence of light, heat and oxygen containing compounds such as benzyl peroxide or hydrogen peroxide.[12, 15, 16] The polymerization process may be retarded by the use of certain reducing compounds as pyrogallol or hydroquinone. The transparent solid resin is readily pigmented, giving it a pleasing natural tissue appearance, and is ordinarily thought to be quite stable in color properties. It is not noticeably discolored by light or heat below temperatures of 200°C. (392°F.) as were some of the earlier denture resins. The solid resin may be depolymerized or converted into the liquid monomer by heating to temperatures from 250°C. (482°F.) to 450°C. (842°F.). This method of obtaining the liquid is said to be in use for some dental products on the market. The possibility of contaminating ingredients, which may have been volatilized and trapped with the liquid, does exist from this practice. As a precaution against tissue reaction of the patient to these ingredients, it is undoubtedly the safest practice to use a product of known origin and tested qualities. Most of the older or the licensed products on the market are considered reliable in this respect.

The specific gravity of the pure polymerized resin is about 1.18 grams per cubic centimeter, which makes it one of the lightest resins known and of about one-half the specific gravity of vulcanite. This is significant to a limited degree from the standpoint of the unit weight of large denture structures, but is of little importance in crown, bridge and inlay prosthesis.

It is generally understood that the liquid monomer of methyl methacrylate acts as a plasticiser of the solid polymer and in dental practice the products are marketed as a liquid and powder which are to be united before processing. When the powder and liquid are mixed by the dentist, a plastic, dough-like mass is produced which may be conveniently packed and adapted to the mold form. Denture resins are also marketed in the form of a plastic cake, or gel, which has been prepared by combination of the powder and liquid by the manufacturer before being distributed. There has been considerable discussion concerning the relative merits of the two forms,[17] but it has not been completely settled whether or not the advantage of one form over the other is a real one so far as general physical properties are concerned. The powder-liquid form is most popular because of ease of manipulation, economy in use and unlimited shelf life. Little difference can be

detected in the major physical properties of test samples or dentures processed from the two forms.[18] The plastic cake is subject to aging when stored in an open package at average room conditions, whereas the powder and liquid form is practically age-proof. The uniformity of color distribution may be a little better in the prepared cake and there remains some question about the resistance to packing of the two forms at elevated temperatures.[19]

Precautions in Mixing Powder and Liquid.—Sufficient liquid should be used to completely wet the powder. It is usually customary to add liquid to the powder, although the reverse practice may be used without apparent harmful effects. An excess of the dough-like mass should be placed in the mold and final closure of the flask should be delayed until the liquid has had a chance to thicken and the mass has stiffened somewhat. Too stiff a mass is to be avoided, as it may prevent complete closure of the flask. Kneading the mass is thought to be unnecessary to successful processing, but will aid in even distribution of the color and promote stiffening. The packing of a mass which is very plastic or not sufficiently thickened will encourage porosity of the finished structure.[8, 10, 15, 20]

Modified Acrylic Resins.— Although methyl methacrylate is the basic ingredient of most dental resins, there are on the market a few products which make use of other synthetic resins for both the powder and the liquid. The tooth restorative resin Enameltone and the denture resin AcRil make use of liquid monomeric styrene to be combined with methyl methacrylate powder. The properties of these copolymerized products have been studied in comparison with other resins which use methyl-methacrylate powder and liquid, but from a practical standpoint little significant difference in properties is observed from the presence of the styrene.[6, 18] Technically, the acrylic-styrene combination presents some interesting possibilities for future study in improvement of physical properties.

The denture resin Exelon and Luxene 44 are reported to employ acrylic-vinyl copolymers.[18] These products show some improvement in water sorption and dimensional change, but are more difficult to process successfully than the methyl methacrylate resins. This combination may include such resins as vinyl acetate or chlor-acetate as a polymer, combined with monomeric styrene and/or a methacrylate. Such a combination of resins is possible, and it represents the type of copolymerization which is generally expected to produce improved dental resins of the future.

Other methacrylates, as ethyl, n-propyl, iso-butyl, etc., will copolymerize with methyl methacrylate. Inasmuch as they all have slightly different characteristics and properties, they exert a specific influence on the copolymerized product.[11, 16] In the case of the ethyl ester, for example, it acts as an excellent plasticiser which may be used to advantage in some products.

PROCESSING OF RESINS

The manner of processing the resin to produce the best finished structure is a confusing problem which is not yet entirely settled. It is probable that a variation in technic has more pronounced effect on the properties of the resin than exists normally between the different products. The variation of processing time and the use of both injection and compression methods for molding have added considerably to the confusion of the problem.

Tylman has outlined the thermal and physical changes that are to be expected during the processing of acrylic resins.[4, 5] On the basis of these changes he has further outlined a program of processing which should produce maximum results in physical properties. It is generally agreed that a prolonged period of gradual heating to the boiling temperature of water is preferable to plunging the freshly packed flask into boiling

water, although exceptions to this practice appear in the literature.[15] It is questioned whether it is prevailing general practice within the profession to gradually increase the temperature, but it is reasonable to expect improved properties from such practice. This is particularly true where large bulks of material are involved, so that excess heat is evolved during processing, which may develop porosity in the finished structure. After the temperature of boiling water (100° C.) (212°F.) is attained, the flask should be boiled for a minimum of one hour. A slightly longer time probably is of no practical significance, but too short a time can be a definite disadvantage.[5, 6]

No evidence has yet been presented to indicate great superiority of the injection method of packing over ordinary compression packing. While there has been considerable discussion of this topic,[20, 21, 22] the general opinion of the profession seems to be that any improvement which is produced in properties during processing by this technic may be offset by the necessary use of specialized equipment and modified technic essential for injection molding of practical cases. Furthermore, it seems that by careful use, the same results can be accomplished by compression molding as are possible by the injection method. There have been no cases reported in which greatly improved properties were obtained by the use of the injection flask. Likewise, no considerable disadvantage to its use has been cited from the standpoint of physical properties of the finished structure.

PHYSICAL AND MECHANICAL PROPERTIES

The possibility of complete understanding of resin properties as they apply to practical problems is made more complicated by the use of the same materials for two widely different restorative branches of dentistry. There is no reason to assume that because the present products are reasonably satisfactory for full and partial denture applications, that they will be equally or more successful in all phases of crown, bridge and inlay prosthesis. Different properties of the resins are often significant in the two applications.

There is now a list of several physical and mechanical properties of acrylic resins which have been studied to a considerable extent by various investigators, or determined from clinical experience during the past five years. All of these are of some practical significance although not of equal value. They include: (1) Pleasant esthetic qualities, as color, taste, odor and cleanliness; (2) compatibility with oral tissues; (3) strength to resist functional stress (transverse, impact, etc.); (4) dimensional stability during and subsequent to processing (accuracy of reproduction of original pattern, shrinkage, warpage); (5) water sorption by imbibition or surface adsorption; (6) relative hardness; (7) resistance to flow; (8) adaptability to a simple technic; (9) ease and success of repair; (10) resistance to solvents, both aqueous and non-aqueous; (11) weight; (12) thermal coefficient of expansion and conductivity; (13) resistance to porosity during processing; (14) tooth breakage during denture construction, and (15) successful cementation of fixed restorations.

ESTHETIC QUALITIES

A pleasing natural appearing resin with permanent color properties has been sought for many years as a substitute for vulcanite. The acrylic resins appear to be quite satisfactory in this respect. A pleasing pink tint of the natural gum tissue can be readily obtained, which seems to be quite permanent under clinical conditions and when subjected to standardized tests with ultraviolet light.[18] The color does not deteriorate appreciably, if at all, with time or after repair. Additions may be made without giving evidence of the attachment. Some discussion has recently appeared to the effect that there is a bleaching or mottling effect in dentures after use for a time.[23] This, however, does not seem to be as common or as

serious as might at first be expected.

In the use of resins for tooth restoration purposes, the problem of pigmentation and matching of surrounding tooth structure is more exact than in denture applications. The ability of the operator to match the surrounding tooth structure is one of the most difficult, delicate and in general, unsatisfactory operations in the use of tooth restorative resins. Although a number of satisfactory tooth shades have been developed, and a successful restoration is possible, the blending of powders to develop the correct intensity of color is as delicate an operation as with any esthetic restorative material. At this time the ability to match and reproduce shades seems to be one significant factor in preventing resins from becoming as popular as was at one time expected. It has been pointed out that any improvement in resin colors probably will not come from modification of the pigment, which seems to be satisfactory, but from a change in the type of resin.[24]

The lack of taste and odor, as well as the cleanliness of the acrylic resins is perhaps as nearly complete as can be desired. They are far superior to resins of the phenolic or cellulose types which were used earlier, and are better in all these respects than vulcanite which they have replaced for denture purposes.

TISSUE TOLERANCE

The acrylic resins seem to be tolerated by the tissues about as well as any material in dentistry. There is no evidence of appreciable soft tissue reaction after five years' use in denture practice. An occasional case of apparent "allergy" is reported from patients wearing acrylic dentures, but the proportion of disturbing cases to the total number in use is very small. By comparison it is perhaps not more than with vulcanite. The reason for this tissue reaction in some cases is not well known.

This problem, combined with a study of the effect of ingestion of small fragments that may be abraded from occlusal surfaces of tooth restorations, may warrant further study at some future date. At present the lack of evidence of any large proportion of harmful effects apparently does not justify such a study, and there seems to be no cause for alarm from the use of acrylic resins at the present time so long as acceptable, standardized products are used.

STRENGTH

The strength of resins is usually determined from comparative studies on impact, transverse, fatigue and tensile properties. A considerable amount of work has been done to determine the comparative strength of the acrylic resins.[6, 8, 15, 20, 23] The information available from both laboratory tests and clinical studies allows one to conclude that acrylic resins have sufficient strength for use in partial and full denture applications. Comparative laboratory tests show the resin to be equal to or greater than vulcanite in this respect and practical experience has supported these tests.

Whether or not the methacrylate resins and their copolymers have sufficient strength for use in crown, bridge and inlay prosthesis is, however, not so well established. A fixed molar to bicuspid bridge, for instance, requires considerably greater stress resistance characteristics than do removable full or partial denture restorations. It has not yet been determined whether or not metal reinforcement of acrylic bridge structures is always essential, but assuming it is, the extent to which the reinforcement is effective has not been established. A number of practical problems are yet to be solved, in which the most suitable type of reinforcement, the effect of reinforcement on the color of the resin, the best means of attachment, and others, are all uncertain and variable factors. There is little question but that either reinforced or unreinforced resin bridge structures covering a long span are subject to considerable distortion during mastication. Such distortion may well cause dislodge-

ment of cemented abutment attachments, and result in ultimate failure. In all cases the operator should give extreme care to the design and extent of the structure.

DIMENSIONAL STABILITY

The problem of dimensional change in acrylic resins during and subsequent to processing is one that has also received considerable study.[6, 8, 15, 20, 25, 26] It has been pointed out that there are five ways in which dimensional change can take place in denture resins.[8] These include: (1) release of internal strain; (2) water sorption, or water loss; (3) chemical change during processing; (4) continued curing after being placed in service, and (5) thermal changes normal in the mouth. In general, it is established that all resins receive some internal strain during processing, which may be released, as warpage, when placed in service. The severity of this change no doubt depends to a considerable extent upon the manner of processing as well as the form of the structure and chemical nature of the resin. The wetting and drying of resins in service combined with the changes that accompany continued curing and temperature variations in the mouth may give an appreciable change in dimensions of the structure after a few months use.

The dimensional instability of the synthetic resins now available has been discussed extensively in the literature. It is recognized that accuracy in reproduction of the original pattern as well as the stability of structural dimensions is definitely desirable in both denture and inlay types of prostheses. Although the extent of the changes possible is now reasonably well known, and some corrective procedures have been suggested, this continues to be one of the most uncertain behaviors of the synthetic resins used in dentistry.

WATER SORPTION

Vulcanite and most of the resins used to replace vulcanite have shown more or less tendency to retain water either by imbibition or surface adsorption.[8, 15] The cellulose resins, for example, were quite unfavorable in this respect. The acrylic resins increase approximately 0.5 per cent by weight after one week in water.[6] The clinical significance of this increase in water content is not clear as it is related to other properties of the resins. Some denture materials of the past have become foul after use in the mouth for a time, presumably by absorption of saliva and its contents, but this behavior is not experienced with the acrylic resins. The imbibition of water or saliva is no doubt responsible for some physical changes, but the extent and effect in practice are still uncertain.

RELATIVE HARDNESS

With a hardness near or greater than that of vulcanite, it appears that the acrylic resins are sufficiently hard to take and retain a polish and to give satisfactory service in full and partial denture prosthesis. All the synthetic resins are comparatively soft so that as a substitute for gold or other filling materials it seems doubtful if the acrylic resins can offer sufficient resistance to masticating forces and abrasion to be of use for all types of restorations. The use of resins for restorations involving extensive occlusal tooth surfaces, therefore, is being seriously questioned on the basis of insufficient hardness.

The Brinell hardness of acrylic dental resins is variously reported to be between 25 and 30, as compared with a Brinell value of 29 for cast 24-k. gold and 54 for 22-k. dark gold alloy.[6] This hardness is probably sufficient for only simple inlays where the possibility of scratching or wear by abrasion is small.

In this connection there is a peculiar behavior noted by operators who are accustomed to observing the fine marginal cement line of well constructed gold inlays. Because the acrylic resin, even though as soft as gold, is not ductile and

cannot therefore be burnished, drawn or adapted during finishing to a fine marginal line, the average resin inlay may not present such a well finished appearance, so free from cement lines, as does from the well constructed gold alloy inlay. This is entirely an operative observation, which to some extent is dependent on the comparative properties of the two materials, as well as the cavity design, the careful manipulation, and finishing of the restoration. This factor, combined with other characteristic behaviors, is tending to make the acrylic resin inlays unpopular with some careful gold inlay operators.

It appears, from data just recently obtained, that the Brinell hardness of the dental resins cannot be increased appreciably by a simple modification of the processing technic. No significant change in hardness was observed by such variations as (1) prolonged periods of boiling (six hours) in water, (2) prolonged heating in water at 160°F. for periods up to forty hours, (3) quick immersion in boiling water, or (4) slow rise from room temperature to boiling which was followed for extended periods of boiling. These different technics produced occasional samples with hardness values as high as 33±2 Brinell, but not sufficiently consistent to be considered of value. After being submitted to temperatures of dry ice for one hour, some samples showed Brinell hardness values of 40 or more, but, after twenty-four hours at room temperature, this superficial hardness had disappeared. Such variations in hardness are not thought to be of appreciable clinical significance.

FLOW RESISTANCE

The property of resistance to flow of dental resins is of most significance in tooth restorative applications. The amount of total deformation of well processed acrylic resins, tested under conditions comparable to those for testing amalgam alloys, has been found to be greater after one week than for 24-k. gold, but less than for dental amalgam.[6] Part of the deformation is elastic in nature and exists only when the load is applied. There remains a permanent flow of about 2.0±0.5 per cent at room temperature after seven days.

Both the elastic and permanent distortion are significant in crown, bridge and inlay prostheses. For example, the elastic distortion may be sufficient to break the cement seal on a restoration, whereas the permanent flow under stress may result in loss of balanced occlusion within the structure. Further clinical study will be necessary to determine if this behavior is typical.

EASE OF PROCESSING AND REPAIR

In general, it is thought that for denture applications the acrylic resins present a simple technic for processing which, in some respects, is perhaps even less complicated than that used previously for vulcanite. It is true that precautions must be observed and care should be exercised to insure a well processed structure, but this same condition prevailed in the use of vulcanite, and to a greater extent for other resin denture materials. The repair of full or partial dentures made from acrylic resins is likewise a successful and comparatively simple operation, with generally no serious difficulties being encountered.

In the use of acrylic resins for tooth restoration purposes, the processing technic is, however, not quite so simple and often not so successful as in denture prosthesis. Many fine operators feel that the technic involved in the preparation of a jacket crown, or even a simple inlay, is too complicated and prolonged, when the merits of the finished structure are fully considered. It is generally believed that the technic is equally complicated for resin as for gold inlays and perhaps as precise in color and dimensional relations as for a fused porcelain restoration. By comparison, the finished structure holds

some questionable properties of strength, hardness and often color characteristics, so that the dentist is too frequently not pleased with the results of his efforts. This is, therefore, another of the handicaps of acrylic resins as applied to tooth restorative prosthesis.

RESISTANCE TO SOLVENTS

The acrylic resins have a water solubility of about 0.1 per cent in distilled water after one week. This solubility is not excessive and apparently has little significant relation to the other properties of the resin. From the practical standpoint the solubility of dental resins in water is not considered an important factor.

Considerable discussion and some concern has existed over the possibility of acrylic resins being dissolved by such non-aqueous solvents as alcohol, ether, chloroform, acetone and "ketones, esters, and aromatic hydrocarbons."[9, 23, 27] Some recent tests to check the danger from vapors of these solvents have been made by suspending samples of acceptable acrylic resins in a closed container with a saturated atmosphere of the first four solvents mentioned. At the end of five hours in the saturated vapor, there was no visible effect of the alcohol and ether vapor on the resin. The acetone and chloroform produced a noticeable softening of the sample after one hour in the saturated vapor. In general, there seems to be no need for alarm regarding this property of acrylic dental resins under practical conditions.

THERMAL CONDUCTIVITY AND COEFFICIENT OF EXPANSION

The acrylic resins are poor conductors of heat when compared with metals and alloys. For inlay restorations this is a desirable property, but for use in denture prosthesis it is generally thought that a good conductor of temperature changes would create a more favorable reaction with the underlying tissue. The acrylic resins, however, have approximately the same conductivity as vulcanite, and generally speaking are reasonably satisfactory in respect to this property.

The thermal coefficient of expansion for the resins is high by comparison with inlay gold alloys, fused porcelain, amalgam and tooth enamel, but in the same order as vulcanite, according to tests reported from the Bureau of Standards.[8] From the practical standpoint, a temperature change from 30°C. (86°F.) to 50°C. (122°F.) in the mouth would produce about 50 microns change in an acrylic denture, which is 0.1 per cent in the posterior of a 50 millimeter wide structure. This is probably an insignificant change for denture purposes. A comparable change, however, of 5 microns change over the same temperature range on a 5 millimeter bridge abutment might be enough to help break the cement seal and dislodge the restoration. This seems especially true when the restoration is submitted to repeated changes in temperature and the resulting alterations in expansion and contraction.

POROSITY DURING PROCESSING

Porosity of the processed resin persists after several years' use and remains an annoying behavior. It usually occurs in thick, bulky structures, although it sometimes appears in small thin restorations. It has been attributed to several factors, among which are: (1) rapid elevation in temperature to 100°C. (212°F.) causing vaporization of the liquid, which is then trapped as gas bubbles in the partially hardened resin, (2) the packing and processing of powder and liquid resin which is too plastic, thus permitting the liquid to vaporize, and at the same time not allowing sufficient pressure to be exerted on the resin mass during closure of the flask, (3) insufficient pressure on the flask during processing or (4) insufficient material in the mold. Any one of these factors may be corrected by adjustment

of the processing technic, as has been pointed out in the literature.[4, 8, 15] Careful manipulation and precautions are necessary, therefore, to avoid porosity in the structure.

MISCELLANEOUS BEHAVIOR

Checked Teeth.—Another of the annoying characteristics of acrylic resins used for denture base purposes is that of cracking and checking teeth during processing. This behavior is generally thought to be caused by the rapid shrinkage of the resin during processing, and to overcome it a number of suggestions have been offered. Among the suggestions are: (a) the correct proximal spacing of the teeth to allow freedom for slight movement proximally during processing; (b) the use of a small amount of plasticizer around the necks of the teeth to increase plasticity of the freshly packed resin which may be an unfavorable practice; (c) the use of an injection flask to increase the pressure during processing, and (d), perhaps the most successful one, slow processing in boiling water. Leader thinks that hard particles of powder with too little plasticizer are responsible for cracked teeth.[10] Some improvement seems to have been effected in this property by the manufacturers and distributors, as it appears to be somewhat less serious now than a few years ago. Perhaps the quality of the porcelain teeth used is also an influencing factor.

Cementation.—The lack of satisfactory cementation behavior is apparently a feature of considerable seriousness in the use of acrylic resins for inlay applications. While it is not known definitely what property of the resin is responsible for this behavior, a number of suggestions have been made. Among these are: (a) the resistance of the resin to satisfactory wetting by the cement; (b) the comparatively high coefficient of thermal expansion of the resin with reference to the tooth; (c) the difference in elasticity of the resin and the tooth, and (d) the operative factors of cavity design. The development of a cement which will give adequate and satisfactory retention of the restoration without injury to the tooth structure is a problem that holds future possibilities.

Tinfoil Substitutes.—In the past it has been considered essential to tinfoil the surface of plaster or stone which is to be in contact with the resin during processing. This was essential, first, to develop a smooth surface on the finished structure that is free of embedded plaster, and, second, to maintain satisfactory color relations in the resin. With the present shortage of tinfoil for this use, there have appeared on the market a large number of tinfoil substituting media. Many of these are at present offered as paste-like substances that can be painted or brushed on the plaster mold and permitted to dry before the mold is filled with the resin. Varying degrees of success are reported from the use of those materials, depending no doubt considerably on the nature of the material being used and to some extent on the care used in the application.

The composition of most products is a trade secret, but undoubtedly it varies to include a wide range of ingredients. From the literature it is judged that the simpler ones may be little more than varying dilutions of sodium silicate or soap, while others are carefully compounded preparations of both organic and inorganic substances. One composition and method for preparation of such a material was announced recently from the Bureau of Standards.[28] It is basically a solution of soluble alginate used with a second or hardening solution of calcium chloride.

Recent experience with two of the commercial products has been reasonably satisfactory with regard to surface appearance and the necessity of a minimum of finishing and polishing. When using the pink resin there was no visible evidence of color change, but with the clear

resin the tendency is to become slightly whitened, or milky in appearance. Probably the present products are not as good as tinfoil, but some of the carefully prepared products are adequate for practical use until such time as tinfoil is again available.

SUMMARY

Denture Base Applications.—In this paper it has been explained that the acrylic resin products used for denture base purposes are now considered to have satisfactory and permanent esthetic qualities, and show compatibility with the oral tissues in the majority of cases. The general strength characteristics and hardness are adequate for full and partial denture structures. The water sorption, although comparatively high, seems to have little harmful effect on the behavior of the resin in practice. The acrylic resins are adaptable to a simple technic of denture construction and are readily and completely repaired when such repairs are necessary. The resins in use have a satisfactory resistance to aqueous solvents and also have a favorable specific gravity which produces a comparatively light weight denture.

Relatively few properties of the acrylic resins are at present considered unfavorable for denture applications. Several of the properties are unfavorable to only a limited degree and are by no means serious. The lack of complete dimensional stability of the resin during and subsequent to processing is somewhat of a handicap. The thermal conductivity of the resins is not favorable for denture uses, but also is as good as vulcanite, which it has replaced. The acrylic resins are subject to porosity if not carefully processed and are likewise susceptible to breakage of teeth during processing. Both these disadvantages can be reduced to a minimum with careful processing technics, so that they should not be classed as complete disadvantages.

In general it can be said that the advantages of acrylic resins for denture base purposes more than offset their disadvantages. The conclusion reached by Paffenbarger and Souder seems to be as satisfactory and complete as any which can be reached on resins for denture base purposes. Their conclusion is that, "At the present time (1942) methyl methacrylate resin and some of its copolymers appear to be, all things considered, the most satisfactory available denture base materials."[8] There is to this time no reason to alter that conclusion.

Crown, Bridge and Inlay Applications.—In an early survey of the use of resins for tooth restorative purposes, Harris, who is one of the most enthusiastic pioneers in the field, concluded that "Acrylics are by no means fool-proof, nor do they offer short cuts. They need merely the same care and attention given to any fine dental restoration."[29] This conclusion is perhaps as true today as when first stated. The present attitude of the profession as a whole, however, is apparently one in which there is a feeling that the quality of the finished restoration does not justify the care and attention which is essential to its preparation. It may be fairly safely concluded also that the men engaged in the research on dental resins, both in the laboratories of dental schools and reliable manufacturers, are not too optimistic about the extensive use of resins in general operative restorations. Within the profession, many operators who have tried acrylic resins for crown, bridge and inlay restorations are not so enthusiastic about their use as they were one year ago.

This attitude has developed in part because the acrylic resins as now produced do not possess so many favorable qualities for crown, bridge and inlay prosthesis as they do for denture base purposes. Those qualities have been enumerated throughout this discussion.

It is probable that the real application of resins to tooth restoration purposes will not be completely established until after

another few years of trial in practice. With an understanding that limitations exist to their extensive use, it may still be concluded that, if properly handled, the resin restoration can give service. Complicated two or more surface inlays and extensive fixed bridge structures are not indicated. All restorations should be conservative, with plenty of body, no bevel, and not used in positions where the bite is heavy. This suggestion of caution is not different from that made by many others during the past two years. Reference to it again is desirable because, so long as this caution is observed, there is little chance that the resins will gain a position in fine operative dentistry which they do not rightly deserve.

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THE PRIVATE PRACTITIONER AND PUBLIC RELATIONS

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THE term "public relations" means different things to different people. To some, it means publicity; to others, it means propaganda, and, to a few, it means a vague kind of glorified handshaking. The fact of the matter is that public relations means nothing more nor less than relations with the public.

Too many of us, I fear, feel that Dentistry's public relations are solely the responsibility of the dental organizations. Actually, it is a cycle that begins and ends in the private practitioner's office. Dentistry's public relations consist of each dentist's relationship with the public, multiplied by the total number of members in the profession. All the public relations endeavors of organized dentistry, that is of the American Dental Association and the state and component dental societies, are futile without the full cooperation of each and every one of our private practitioners. No dentist can avoid his public relations responsibility. His very existence in the profession depends on his relations with his patients and therefore with the public. It is only sensible that the private practitioner, like the dental society of which he is a member, shall pursue a positive rather than a negative public relations attitude and that he shall develop a true appreciation of the important part that he plays in dentistry's public relations.

In its public relations activities, the American Dental Association endeavors to present the dental profession as a scientific body and the members thereof as scientists and humanitarians. The activities of the Bureau of Public Relations can be grouped under three headings:

1. Education of the public in all matters pertaining to the care of the teeth.
2. Efforts to increase the public's regard for dentistry as a profession.
3. An endeavor to keep dentistry in the front in all civic and health endeavors.

Only in recent years has our Association consciously pursued a positive course in public relations. Nevertheless, ever since its inception as a profession, Dentistry has unconsciously, yet fairly successfully, developed desirable relations with the public. This has been particularly true during the past third of a century. Thirty-five years ago, a young man entered the practice of dentistry strictly as an individual. State dental societies were comparatively weak. In most communities, district or component societies did not exist. The American Dental Association, or the National Dental Association as it was known in those days, had only 689 members. A dentist was known as a tooth carpenter or tooth puller. He was just beginning to emerge as a member of a profession and his status as such was viewed with a certain amount of distrust and misgiving. The improvement in dental education, the strengthening of dental legistion, the efforts to improve public education, all have helped raise dentistry in public esteem.

In the stress of establishing dentistry as a profession, in the strain of improv-

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ing its technics and science, Dentistry's early leaders gave little consideration to the necessity of keeping the public informed as to its purposes and achievements. Consequently, the public has never been more than remotely acquainted with Dentistry's objectives, with the result that, in most instances, the public has been either disinterested or downright antagonistic to dentistry's welfare.

For instance, during the thirties, advocates of state health service pictured dental service as disproportionately expensive and portrayed dentists as hardened and antisocial, their interests in humanity and its suffering regulated by the size of its fees. Had the American Dental Association not stepped in and presented its side of the story, lay leaders would still retain the opinion that dentistry is a luxury. The American Dental Association, through its Committee on Economics, National Health Program Committee and Bureau of Public Relations, has been able to convince many social leaders that dental care is no more expensive than other necessities of life. Furthermore, they have been able to prove that the successful approach to the dental problem lies through preventive rather than reparative dentistry. The transformation that took place in the thinking and utterances of our most vociferous state medicine advocates between 1932 and 1939 was both amazing and gratifying. Sociologists who in 1932 and 1933 knew that America's dental problems could be solved only by providing free dental service to the low-income group were, by 1938-1939, advocating dental education and preventive dentistry for all as the best solution of those problems. This changed concept was brought about by public education and public relations.

Older members of the profession recall that dentistry in both the Army and the Navy, prior to the First World War, occupied a very unenviable position. Not until October 1917 was legislation passed granting dental officers equal status with officers of the Medical Corps. The dental division of the U. S. Public Health Service was not established until 1920. Dentists in all branches of federal service fought a losing battle for recognition. During the following twenty years, federal officials developed a new and better concept of dentistry. In the present war, in both the Army and the Navy, Dentistry is recognized as an important branch of military health service. This change in concept has been brought about through the effort of American Dental Association officials, the Committee on Legislation, the Dental Educational Council, the Dental Preparedness Committee, the Advisory Committee to Selective Service, the Committee on Dentistry of Procurement and Assignment and other representative groups. In other words, the changed concept was brought about by good public relations.

Until recently, the National Education Association, the U. S. Children's Bureau, the National Congress of Parents and Teachers, the American Red Cross, the American Medical Association and many other national organizations gave no consideration to dental disease in deliberations on their health and educational problems. Today, dentistry's representatives sit at their conference tables and contribute their share to the betterment of humanity. Another evidence of good public relations.

Not so many years ago, the only mention made of dentistry in the news was the occasional story poking fun at the profession, or an article headlining Dentistry's defects. Today, news editors find much of interest in dental research and publish hundreds of lines daily on dental subjects. Science editors of wire services, magazines, newspapers and radio constantly consult the Association for authentic dental information. This change in attitude on the part of editors has been brought about largely through

the efforts of the Association's publicity committee and the Committee on Public Health and Education, which is now a subcommittee of the new Council on Dental Health. Good public relations in action.

Sufficient examples have been cited to demonstrate that the public relations of the Association is not the responsibility of any one committee or department of the dental society or the Association. It is the *motif* of all the activities. Public relations is an operative philosophy to be applied to everything your dental society does. Public relations has come to mean the art of getting along with the public. Upon what the public thinks of the profession rather than what the profession thinks of the public depends the progress of the profession.

Dental public relations consists of (1) developing the proper attitude toward the public; (2) putting those attitudes into action, and (3) letting the public know about it.

Many examples can be cited from the world of business, and certainly from the realm of government, making it clear that this approach to public relations is hardly original. Every one is familiar with the metamorphosis of John D. Rockefeller from a newspaper ogre charged with all manner of oily sins into a benevolent gentleman who distributed dimes to children and millions for the betterment of mankind.

Paul Garrett, of General Motors, once said:

> Public relations is not something that can be applied to a particular business; nor is it an umbrella covering everything but touching nothing. It is a fundamental attitude of mind, a philosophy of management which deliberately and with enlightened selfishness places the broad interest of the public first in every decision affecting the operation of business.

Surely, we as dentists must have this fundamental attitude of mind, and we must follow the enlightened philosophy of placing the public interest first in all transactions between the public and the profession.

The success of Marshall Field's, one of the greatest mercantile establishments in the world, is based on the creed that the customer is always right. Surely, if such a creed can be successfully applied in business, it can do no less for a profession. "The customer is always right," which is the basic principle of good public relations, is simply the modern American way of saying, "Do unto others as you would have them do unto you." It is in line with our ideal national philosophy and diametrically opposed to the philosophy of Hitler, Mussolini and Hirohito, which has plunged the world into its present chaotic condition.

Every dental organization that does not practice the principle of good public relations is undermining the dental profession. Every dentist who does not deliberately make of himself an ambassador of good will for Dentistry lowers both himself and his profession in public esteem. Without this positive public relations attitude on the part of both the private practitioner and the dental organization, Dentistry is incapable of serving society to the fullest extent of its capacity.

It is well to remember that we as dentists have but one string to our fiddle, and that string should be tuned to service. Dentists are men of service. We can never do more and we should never do less than serve society to the very best of our ability.

That brings us face to face with certain social problems that are confronting the world today. Fortunately, Dentistry has never closed its eyes to the changes that have taken place in recent years in social thinking and social planning. As we look back over the past half century, we find that Dentistry has always been in front in movements designed to improve the health of our citizens. For years, Dentistry's leaders

fought unaided to establish dental preventive programs for children in our public schools. In spite of accusations leveled at the profession by oldline educators, public health officials and others that Dentistry was motivated solely by self-interest in advocating preventive dentistry for school children, dental leaders, sincere in their beliefs, used every ethical means to break down the barriers of inertia and skepticism.

In 1918, North Carolina established the first state dental public health service. Today, twenty-five years later, forty-four states have dental units in their health departments. The Cincinnati Dental Society pioneered in the field of preventive dental service for children. As you all well know, it was more than thirty years ago that a committee from the Cincinnati Dental Society, under the leadership of Sidney J. Rauh, inaugurated your school dental program—a program which has grown and expanded until it is one of the outstanding municipal school dental projects in the country.

Certainly, in the light of the facts written on the pages of history, Dentistry cannot be justly accused of ignoring its social obligations, and if past performances can be used as a criteria, the dental profession will assume its full responsibilities in the social changes that at this time seem to be inevitable.

There is every evidence that our leaders are well aware of Dentistry's responsibilities and are bending every effort to fulfil them to the satisfaction of both the public and the profession.

It must be borne in mind, however, that the dental profession's relations to the public and the public's attitude toward the profession are modified for better or for worse by the public relations attitude of every private practitioner. Let us cite a few examples of poor public relations attitudes:

It has long been advocated by dental authorities that children's teeth be given early and thorough dental attention. Dental societies recommend this procedure to other health organizations. Hence, the dentist who advises parents that it is unnecessary to care for the deciduous teeth is practicing poor public relations.

For years, organized dentistry has endeavored to create the concept that dentistry is a profession, not a trade, and that a dentist is a professional person, not a tradesman. The dentist who conducts his practice on the basis of selling merchandise such as dentures, crowns and bridges rather than on the basis of rendering a health service is practicing poor public relations.

The advertising dentist with his garish electric signs and cheap merchandising methods has long been Dentistry's greatest offender in the public relations field. How can the public be made to understand that dentistry is a health service when garish signs and glaring headlines advise them that they can buy dental service as they buy merchandise and groceries?

But the advertising dentist is by no means our only offender. Unfortunately, there are few of us within the ranks of organized dentistry, who consider ourselves ethical practitioners, who are without fault. The dentist who is careless in his personal appearance, whose hair is uncut, whose face is unshaven and —crime of all crimes—whose teeth are unclean, decayed and unsightly, is promoting the worst type of public relations.

The dentist who permits his office to become slovenly, who allows dust and grime to collect and dog-eared magazines to clutter up his waiting room, and who permits his operating room to be anything less than immaculately clean, practices poor public relations.

The patient's opinion of the entire dental profession is molded by the impression he gains of his own personal dentist.

Another offender from a dental public relations view point is the loud-mouthed,

slightly inebriated member who persists in informing all within earshot that he is a dentist. If one should accidentally become inebriated, let one confine oneself strictly to the business at hand and keep one's calling in the background.

By this time, some in the audience have come to the conclusion that the dentist's role in public relations should amount to no more than good manners and good citizenship—and this is exactly the conclusion that I hope you will draw.

The last few statements have been very personal, dealing with an exceedingly touchy subject. They were not meant to offend. The examples were cited to show how important it is that every dentist, no matter where he is located and no matter how large or small his practice, develop a positive public relations attitude. One of the best things that can happen to any of us is the gain in stature resulting from refreshing ourselves in professional concept. W. A. Shumaker, editor of "Law Notes," says:

> If there is such a thing as a profession as a concept distinct from a vocation it must consist in the ideals which its members maintain, the dignity of character which they bring to the performance of their duties, and the austerity of the self-imposed ethical standards. To constitute a true profession there must be ethical traditions so potent as to bring into conformity members whose personal standards of conduct are at a lower level, and to have an elevating and enobling effect on those members. A profession cannot be created by resolution or become such over night. It requires many years for its development, and they must be years of self denial, years when no results bring honor except those free from the taint of unworthy methods.

In this statement, we may all find the inspiration and the practical suggestions necessary to good manners, good citizenship and good professional attitudes—all of which combine to make good public relations.

Before remarking specifically on the public relations projects which should be undertaken by Dentistry, let us touch upon one more aspect of public relations. It has to do with the sense of proportion demanded in dealing with the public and with the media which carry our public relations messages to the public.

Now and then, in print or on the radio, we come across some joke about the dentist or some unflattering pseudo-scientific reference to dentistry. Sometimes, a bedeviled advertising copy writer or cartoonist will reach into the bottom of his barrel and come up with an unfortunate blurb or drawing. And, as a matter of fact, some of our worst radio comedians are at their best in a fictional dental office or chair. I have actually enjoyed some of these bits of nonsense myself without any feeling of guilt.

My enjoyment ends with the morning mail, which is sure to contain blistering denunciations directed at the perpetrators of these crimes against dentistry, sent in by well-meaning, indignant dentists to the authors of the uncomplimentary attacks, with copies directed to the A.D.A. Bureau of Public Relations.

I am happy to say that, in recent years, these reactions to inanities are not so numerous as in the past. And there will always be those who contend that dentistry has no right to "stand" for such occurrences.

As a matter of fact, there are few, if any, professions that escape the occasional poke in the vein of the "mother-in-law" joke. It is poor public relations to send vitriolic protest to the author or editor. That simply makes them angry, resentful and vindictive toward the profession. Write a letter, of course, if you feel the necessity, but write a friendly letter pointing out the evil effects of the article on the public's health—don't harp on the indignity to the profession. The Bureau of Public Relations occasionally finds it necessary to write to radio and news editors, but we always use a posi-

tive rather than a negative approach.

When dealing with masses of people, through many types of media, we keep a ledger of credit and debit regarding the material that appears before the public. At the end of the year, we compare the credits with the debits, knowing that positive activities will certainly increase our credits and knowing too that there will be something on the unpleasant side. It is the sense of proportion which should guide our thinking when that old wheeze about the dentist comes nasally from our radio, or when the town dentist in a romantic novel is cast in an unheroic rôle.

If we feel that a misstatement has been made, or that there is a vicious objective behind the item, certainly the author can be contacted and a complaint made in conformity with public relations standards and our own positions as professional men.

A certain author of a health column widely circulated in America has been led to change his entire treatment of dentists and dentistry in the last year or so by the diligent application of this approach through the proper channels.

Now, as to the specific problems in a dental public relations program: At the beginning, we outlined the three purposes of the public relations program for organized dentistry. Let us briefly discuss them.

Every dental society might well have a public relations committee. It should be large enough to include members to be assigned to a variety of tasks, with all endeavors integrated by the chairman.

Besides having some natural ability for certain public relations work, each member of the committee should have the will to channel his enthusiasm through carefully planned lanes of action.

What are some of the things the public relations committee can do to keep the dental society in the front of civic and health endeavors of the community?

1. Establish and maintain contacts with the local health departments and boards of education, offering those agencies the society's assistance at all times. Nationally, the Bureau offers its services to state health departments, in addition to furnishing educational material to all agencies.

2. See that the society actively participates in the annual summer round-up of the children conducted by the parent-teacher associations, as a regular part of the public relations program. The A.D.A. Bureau of Public Relations is prominently active in the national arrangements for this P.-T.A. activity.

3. Make and maintain contacts with the P.-T.A., women's clubs, civic and fraternal organizations, etc., that cooperative endeavors may be furthered, with the dental society assuming an active rôle.

4. Keep well in the front in the community's wartime efforts, particularly in those areas where war industry and military concentrations exist. Guidance in activities may come from the society's military affairs committee.

As to the first purpose of the public relations program, "To educate the public in the care of the teeth," the work may be accomplished in these ways:

News releases should be sent to the daily and weekly newspapers on some phase of dentistry and dental care. At least one release of this type is furnished each month in the A.D.A. Public Relations Bulletin, which every public relations chairman should receive. The bulletin carries news and suggestions of special interest to public relations committees.

Timely releases should be sent to industrial house organs and publications of various community organizations. Editors of these publications should be contacted to develop special articles which "tie in" specifically with the group's particular interests.

Arrangements should be made for of-

ficers of the dental society to lecture at school assemblies, club meetings, etc. The Bureau of Public Relations of the A.D.A. has available a wide variety of lectures, many with illustrative slides and motion pictures.

Arrangements should also be made for members of the dental society to make radio addresses. The Bureau has available several complete radio series and special radio talks.

When feasible, an annual dental health day or week should be arranged as an important community health education project. The time of the annual meeting of the society is frequently considered the best time for this observance, and dental health exhibits for the public can be arranged at the meeting.

Under the second purpose of the public relations program, "To advance the public's regard for the services of dentistry," we make these suggestions:

The monthly meetings, and especially the annual meetings of state and component societies, serve to place dentistry squarely in the news spotlight of the community. The meetings should be publicized. If possible, at least one function in which the public may participate should be included in the program. Public officials and representatives of civic, school and health groups should be invited as program speakers or as panel discussers. The public relations committee chairman should have a voice in the planning of every important meeting of his society and be ready to suggest inclusion of program events which will advance the public relations program.

Under this heading also comes the suggestion that contact be established with high school faculty advisers so that students considering a career in dentistry may consult society officials and receive authoritative advice and assistance. In this way, through public relations contacts, the highest type of young man and woman may be encouraged to enter our profession.

These are, in outline form, the suggestions which the Bureau makes for a society's public relations program. Some of the activities, such as the preparation of news releases, can best be accomplished with professional assistance. If funds are available, professional publicity agencies may be retained. The circus press agent type of man is, of course, not desired and, as a matter of fact, he has almost disappeared from the field. In most cities, the newspaper's city editor will recommend an agency that has gained a reputation for the kind of work required by the society.

As for the other activities which have been outlined, accomplishment depends on steady, well-planned and directed work. The approach must always be strictly in accordance with the dignity of our profession—a dignity which is a fact and must be maintained at any cost of newspaper lineage or public relations contact.

If what I have said about the dentist's rôle in public relations strikes you as adding up to a great deal of effort and a great deal of professional soul-searching, I have a word of real encouragement for you:

Dentists who have turned their attention to their society's tasks in public relations tell me, almost without exception, that in this work they have found their most stimulating experiences as members of organized dentistry.

As dentists, we serve the public. Our lives are bound to that service. Greater rewards will be found in greater service. That is our destiny.

PROPHYLACTIC USE OF SULFATHIAZOLE IN ORAL SURGERY: A CLINICAL STUDY

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EVER since the sulfa drug made its dramatic appearance in the healing arts, progressive members of the dental profession have been actively examining its possibilities in the control of infection following surgical procedures in the mouth.

Early investigators used sulfanilamide both systemically and locally, but, when the preliminary reports of their findings were published, it was found that their results varied greatly. Some obtained beneficial effects, while the results of others were discouraging, the use of sulfanilamide in the alveolus after a simple extraction increasing the postoperative pain and swelling and retarding granulation in certain cases.[1]

However, as clinical studies continue, it has been found that sulfathiazole, a derivative of sulfanilamide, topically applied in wound areas, gives good results. Numerous papers have been written in praise of the beneficial effects of local sulfathiazole therapy.

It was believed that another study of the efficacy of sulfathiazole could be made in this institution under definite environmental control, which plays an important part postoperatively and which is not available to the private investigator. As part of a regimented social group, all patients have the same diet, work an equal number of hours, indulge in similar recreational facilities and enjoy the same hours of rest and sleep.

Therefore, from December 15, 1942, to February 20, 1943, the effects of the use of sulfathiazole locally as a dusting powder was observed in 100 unselected routine surgical cases of the mouth. All patients were male adults, ranging in age from 18 to 74 and comprising a mixed group of native-born whites and Negroes, Puerto Ricans and alien Italians. Fifty patients received sulfa therapy, while fifty were maintained as controls. Those on sulfathiazole were permitted no mouthwash or sedative treatment. The control group was allowed the acceptable postoperative routine of warm saline rinses three to four hours after operation, and 10 grains of acetyl salicylic acid for sedation. The 100 cases involved single and multiple extractions, with a total of 237 teeth removed, seven of which were impacted, fifteen alveolectomies and the removal of four large cysts.

The technic of administration was as follows:

After each operation, the wound area was carefully swabbed free of blood and saliva. Then some coarse sulfathiazole powder, made by crushing a 7.7 grain tablet, was dusted into the sockets and bruised tissues with a large curet. For single extractions, one-half tablet was used, approximately 3.8 grains. However, in no case was more than 7.7 grains used.

All areas under treatment were carefully examined for loose fragments or sharp edges of bone. If these are not removed or filed smooth, a true evaluation of postoperative results cannot be made. Prophylactic medication must be

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based upon surgical principles. It cannot obscure negligence on the part of the surgeon. A record of the degree of trauma per operation was also kept, since this is a variable having a direct effect on postoperative pain, and hence on the interpretation of results.

Since every surgical procedure, however slight, involves some trauma, it was decided to rate all simple, uncomplicated extractions, in which only soft tissues were lacerated, as S.T., or "slight trauma," cases. Multiple extractions, impactions, alveolectomies and cyst removals that incurred extensive injury to soft tissues and bone were designated as M.T., or "much trauma," cases.

Table 1.—Total Analysis

	Sulfa Group 50Cases	Per Cent	Control Group 50Cases	Per Cent
No complaint	29	58	24	48
Soreness	21	42	26	52
Rapid healing	30	60	18	36
Slow healing	20	40	32	64

Table 2.—Slight Trauma Cases

	Sulfa Group 15Cases	Per Cent	Control Group 33Cases	Per Cent
No complaint	10	67	23	70
Soreness	5	33	10	30
Rapid healing	8	53	15	45
Slow healing	7	47	18	55

Patients were recalled forty-eight hours after operation for examination and questioning. If the tissues showed no signs of inflammation, good organization of the clot and progressive closure of the wound, healing was considered rapid. However, if inflammation was still present and the socket open, with a poorly organized clot, healing was rated as slow. For those who had no complaint to make regarding pain and discomfort, notation was made to that effect, while the cases of those expressing pain, no matter how slight or severe, were tallied together in order to eliminate any question that might arise concerning individual thresholds of pain.

Observations were also made as to systemic reactions; i.e., whether nausea, rash or headache developed after application of the sulfathiazole.

The tabulated results are shown herewith.

Under total analysis, the percentage of cases showing rapid healing and no complaints with sulfathiazole ran higher than that of the controls in the corresponding classifications. Also, the percentage of soreness and slow healing in the sulfa group was lower than that in the control. A 24 per cent difference in the rates of healing between the two groups and a 10 per cent difference in the incidence of postoperative pain expressed indicate that sulfathiazole acts both as an infection and a pain controlling agent, but apparently serves better in the former capacity.

Table 3.—Much Trauma Cases

	Sulfa Group 35Cases	Per Cent	Control Group 17Cases	Per Cent
No complaint	19	54	1	6
Soreness	16	46	16	94
Rapid healing	22	63	3	18
Slow healing	13	37	14	82

When a closer qualitative analysis is made on the basis of trauma incurred, a more significant interpretation is achieved. Of the S.T. cases receiving sulfa therapy, there was a smaller percentage of no complaints and a higher percentage of soreness than in the control. These results appear to agree with those of other workers who found the sulfonamides a hindrance rather than an aid. However, a 3 per cent difference between the groups is, I believe, not great enough to warrant serious consideration.

The experimental group displayed proportionately more rapid healing and

a lower percentage of slow healing than the control group. Here again, the 8 per cent differential is not considerable.

It would be safe to say, on the basis of the foregoing results, that, in operations causing slight trauma, the possibility of postoperative pain is approximately the same whether sulfathiazole is used or not. Also, the rate of healing is about the same, those receiving sulfathiazole showing a slightly higher one.

With the cases of much trauma, a marked difference is evident. In the sulfa group, 54 per cent of the patients made no complaint; whereas only 6 per cent in the control group were in that category. Conversely, 94 per cent in the control group complained of soreness and tenderness; while only 46 per cent of the experimental group complained of these conditions. A difference of 48 per cent between the two groups represents decidedly better control of postoperative pain under sulfathiazole therapy. As for rate of healing, a similar sharp distinction is apparent. Sixty-three per cent of the sulfa group, as against 18 per cent of the control, showed rapid healing; while only 37 per cent of the sulfa group showed slow healing and 82 per cent of the control. The 45 per cent difference is indicative of an improvement in the matter of healing.

No case of infection developed in the experimental group. Neither was there one case of an unfavorable general reaction to the sulfathiazole.

Only one case in the control group developed dry socket.

It appears, then, from these observations, that, in slightly traumatic procedures, sulfa therapy should not necessarily be preferred to the routine saline rinse and acetyl salicylic acid. However, when considerable trauma is involved, its use has a decidedly beneficial effect in controlling postoperative pain and infection and accelerating healing of the tissues.

The results of this study, on the whole, are in agreement with those of the majority of other investigators who have done similar work. These previous observers, however, make no mention of control groups in the publications reviewed, their findings being based solely on clinical observations of surgical procedures in which sulfathiazole was used, and not including carefully tabulated results on those receiving other routine postoperative treatment.

SUMMARY

The results of prophylactic use of powdered sulfathiazole locally was observed in 100 unselected routine cases of oral surgery. The patients were a heterogeneous group of male adults ranging in age from 18 to 74. All were members of a regimented social group under definite environmental conditions that play an important rôle postoperatively. Fifty patients received sulfa therapy and fifty were maintained as controls, receiving a saline mouthwash and acetyl salicylic sedation. In all, 230 teeth were extracted, seven impacted teeth removed, fifteen alveolectomies performed and four large cysts extirpated.

RESULTS

For controlling postoperative pain and infection in cases of slight trauma, sulfathiazole therapy is no better than the use of saline mouthwashes in conjunction with acetyl salicylic acid sedation. The incidence of complaints of postoperative discomfort and the rate of healing in both groups were approximately the same, the proportional differences being too small to warrant consideration.

Under conditions of excessive trauma, sulfathiazole therapy decidedly reduces the amount of postoperative pain and tenderness, as shown by the control group, and also greatly hastens the healing of tissues.

Not one case in the experimental

group developed dry socket or other infection. One case in the control group did.

Because the amounts used and absorbed were small, in no case did a patient exhibit any untoward general reaction to the sulfa drug.

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EVALUATING TEXAS DENTAL HEALTH PROGRAMS

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FOR the past year or two, we have heard the question as to whether the dental health programs over the country are actually paying dividends. To us who are in the field of dental public health, it is very obvious that they are showing valuable results.

We know that they are noticeably and definitely raising the standard and increasing the appreciation for dental health on the part of the general public, as well as among professional groups. We know that the educational efforts among school and preschool children, and even in adult groups, are bringing dental health nearer to its proper rank in importance. But dental public health is comparatively young. As with any other educational program, it will require time and new generations in order to actually measure the progress.

We felt that it was hardly fair to dentistry to expect us to show results that would be comparable to those in other phases of public health in which programs have been in progress much longer; but since the questions were being asked, we, in Texas, felt that it behooved us to study our results and, if possible, to show data and figures bearing out our contention that the programs are paying.

Several reports of dental health programs were noted, and since it seemed that the accepted standard for evaluating dental health programs, and perhaps the only dependable one, is the mortality rate of permanent teeth, we determined to study the Texas programs on that basis.

CORPUS CHRISTI CLINIC PROGRAM

With the opening of the school year 1937-1938, a full-time public health dentist was assigned to the City-County Health Unit of Corpus Christi-Nueces County. In this, and in other subsequently instituted programs, the work is chiefly educational, and is directed for the most part to school and preschool groups. It also includes clinical services for indigent children of the lower grades,

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with semiportable equipment, setting up clinics in the school buildings and having under observation all children of every financial bracket. Thus, the clinical work becomes one of the most effective parts of the educational program. Since the first year was spent largely in organization, examinations, etc., we took the data on permanent extracted teeth in the clinics from year to year, beginning with 1938.

ninety-eight permanent teeth were extracted, a rate of 24.37 permanent tooth extractions per hundred children. In 1939, for 1,263 patients, the rate was 17.34 permanent teeth extracted per hundred children. In 1940, the rate was 10.35; in 1941, 6.48; in 1942, 3.5. Of course, this could not be accepted as conclusive evidence of the value of the program as a whole, but it was regarded as indicative when we noted the uniformity

EVALUATION OF TEXAS DENTAL HEALTH PROGRAMS
Permanent Tooth Mortality Rate*

Locality	Number Children Examined	PTMR	PTMR for Upper Teeth	PTMR for Lower Teeth
Jacksonville schools (No dental program)	1,029	26.4	6.1	19.53
Zavala school (Part-time clinical program)	482	13.07	3.27	9.8
Greenville (Full-time program for three years)	1,300	9.9	1.5	8.4
Corpus Christi (Full-time program for six years)	1,153	7.4	1.3	6.1
Nueces County (Full-time program for six years)	1,453	6.4	0.9	5.5

*Teeth missing and extractions indicated per hundred students.

Permanent Teeth Extracted Nueces Co. Clinic from 1938 to 1942

1938		1939		1940		1941		1942	
Patients	PTER	Patients	PTER	Patients	PTER	Patients	PTER	Patients	PTER
402	24.37	1,263	17.34	1,469	10.35	956	6.48	1,281	3.5

†PTMR, permanent tooth mortality rate.
‡PTER, permanent tooth extraction rate.

It should be borne in mind that in these indigent children of the lower grades all teeth needing extracting were extracted. There were a few emergency extractions for the upper grade pupils. The data were based on the number of permanent teeth extracted per hundred children. To our amazement and satisfaction, we found a rapid and steady decrease in the number of permanent tooth extractions required.

For the year 1938, for 402 patients,

of the decline in extraction of permanent teeth.

Now, naturally, the question arose as to the results with the children of the upper financial brackets through our educational program. Were we inducing them to go to their family dentists for corrections, and were they absorbing our prevention teaching sufficiently to assure a noticeable reduction in the mortality rate for permanent teeth? After all, they are in the majority and are perhaps far

more important as far as usefulness as future citizens is concerned; so we devised a plan to measure the results by including the children of every financial status.

JACKSONVILLE PERMANENT TOOTH MORTALITY RATE SURVEY

Jacksonville was selected as an average Texas town where there had been practically no organized dental program. Jacksonville was selected too because the municipal water supply for many years has been from surface lakes and contains almost no fluorides (less than 0.4 parts per million), the presence of which might reduce the incidence of dental caries. Native-born children of the public school, from 6 years old through 18 years old, to the number of 1,029 and living continuously in Jacksonville were selected for a careful mouth mirror and explorer examination.

All permanent teeth extracted within the past twelve months, and permanent teeth which, in the judgment of the examining dentist were beyond the possibility of saving with impunity, were counted as permanent teeth lost. In the 1,029 children, there had been 264 permanent teeth lost; a rate of 26.4. (Hereafter, permanent tooth mortality rate per hundred children will be referred to as PTMR.) Had all permanent teeth extracted through life been counted, obviously the rate would have been raised by several points, possibly to 30 or above. This we know to be a very low rate as compared with that from other surveys which have been made in the New England and northern states, but it is generally agreed that the caries rate all over Texas is lower than the average, probably owing chiefly to the varying, but almost universal distribution of fluorides in the waters in Texas.

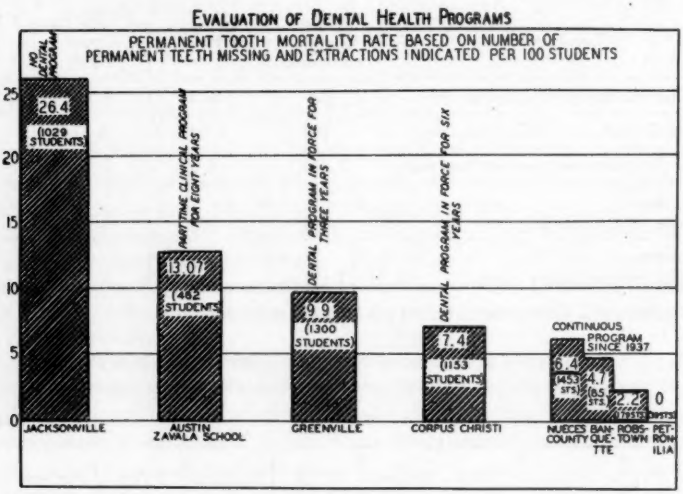

Figure 1.

ZAVALA SCHOOL, AUSTIN

One large school was surveyed in Austin, where for the past eight or nine years the schools have maintained a part-time, purely clinical program for indigent children. By purely clinical, we mean that little organized dental health educa-

tion has been carried on, though, of course, through the clinical procedure —examinations, screening, and contacts —there has been considerable stimulus for upper bracket children to visit their family dentist.

In Zavala School, the children were selected who had spent their entire public school life in that school. This gave us 482 children. We counted all permanent teeth extracted, and permanent teeth that could not be saved by dental procedures. The 482 children examined

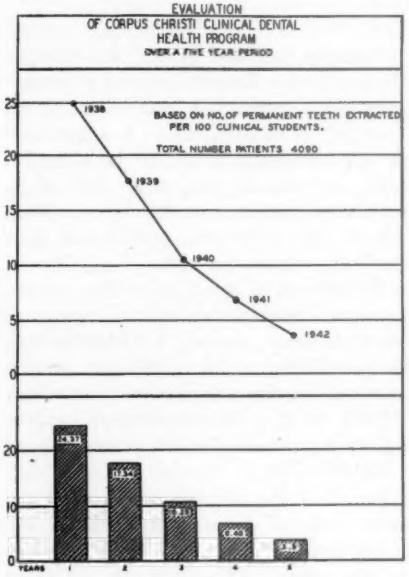

Figure 2.

showed a PTMR of 13.07. This, you will note, is almost exactly one-half the rate at Jacksonville, where there has been no dental program. In other words, it is obvious that even the part-time clinical program has reduced the dental health hazards by 50 per cent.

CORPUS CHRISTI-NUECES COUNTY

Now, we were eager to see what the PTMR would be for the whole group of children in Corpus Christi and Nueces County. As the full-time dental program had been under way since 1937, we selected only children who had lived there since the beginning of 1937 and had been exposed for the nearly six years to the program. In the city of Corpus Christi, the 1,153 children selected showed a total of eighty-six permanent teeth lost, or a PTMR of 7.4. The rate for the county of Nueces, including Corpus Christi, was slightly lower. For 1,453 continuous resident county children, there were ninety-four lost permanent teeth, or a PTMR of 6.4. The most logical reason for the slightly lower rate in the county than in Corpus Christi is a sprinkling of fluorides in low concentration in some of the county waters. In one small school, Petronilia, where there were thirty-nine children with a history of continuous residency, not one permanent tooth had been lost. Petronilia has just over 2 parts of fluoride per million in the well waters of the school and community. While this is not intended as a study on the correlation of fluorides and caries and permanent tooth loss, it is interesting to note these significant variations.

Again let us emphasize the fact that this survey included all children from 6 to 18 years of all financial levels. It should be borne in mind that almost the entire PTMR in school children is based on the loss of first permanent molars. Of the PTMR in Nueces County, 97 per cent was accounted for by loss of first permanent molars. In our Texas full-time dental health programs, special emphasis is placed upon the conservation of the first permanent molar, both in the clinical work and in the class-room educational work. So emphatically has the importance of saving this tooth been drilled into the school children that they actually consider it a disgrace to allow a defective first permanent molar to go untreated. This special emphasis, we believe, is largely responsible for the

rapid and radical reduction in the PTMR.

GREENVILLE SURVEY

At Greenville, a city of about 13,000, in the northeastern part of the state, in Hunt County, a densely populated county, a survey was made in which only school children of the city of Greenville were used since there is a sprinkling of fluorides over the county. The full-time dental program was begun there in the fall of 1940. Only children were selected who have resided and gone to school there continuously since the beginning of the program, three years. As this program is just half as old as the one at Corpus Christi, we were eager to see whether the PTMR would prove to be consistent with that of the other points studied according to the ages of the programs.

The 1,300 children who were selected for examination showed a PTMR of 9.9. This rate, which, in our judgment, is consistent with the other points of study according to the age of the program, strongly indicates that, while we do not know exactly what the PTMR was at the beginning of the program, using the Jacksonville survey with a 26 PTMR, and other reported surveys in other states of from approximately fifty to more than 100 PTMR as a control, we are bound to conclude that, by another two or three years of continuation of the full-time program there, the rate will be at least comparable to that of Corpus Christi-Nueces County.

Skeptics may ask about the percentages of racial stocks in the various places. For the most part, the samples have been average white American children. No Negroes were studied. The Zavala School at Austin is purely Latin American. In Corpus Christi-Nueces County, 8 per cent were Latin American. It is interesting to know, however, that, in Corpus Christi-Nueces County, the PTMR is decidedly higher for the Latin American than for the Anglo-American children; which would indicate that, with exclusion of the Latin Americans, the Corpus Christi rate would be even lower.

It was noted that the PTMR was very much higher in the lower arches than in the upper. In the Jacksonville schools, the ratio was 3:1 (three lower to one upper). In the Zavala School, it was 3:1. In Greenville, it was more than 5:1. In Corpus Christi, it was almost 5:1; and in Nueces County, it was more than 6:1.

RECAPITULATION

Indigent clinical cases in Corpus Christi-Nueces County showed a permanent teeth extraction rate of 24.37 in 1938; 17.34 in 1939; 10.35 in 1940; 6.48 in 1941, and 3.5 in 1942. Jacksonville, with no dental program, showed a permanent tooth mortality rate of 26.4. Zavala School, Austin, with a part-time clinical program for eight years, showed a PTMR of 13.07. Greenville, with a full-time educational service program for three years, showed a PTMR of 9.9. Corpus Christi, with a full-time service program for the past six years, showed a PTMR of 7.4. Nueces County, with a full-time program for six years, showed a PTMR of 6.4.

In all of the points studied, the mortality rate of permanent teeth in the lower arches ran very much higher than in the upper. This variance ran from 3 to 1 to more than 6 to 1 in the various localities, as shown in the table and Figures 1 and 2.

CONCLUSION

If the mortality rate for permanent teeth is a dependable unit of measurement in the evaluation of dental public health programs, as is generally accepted in public health circles, it is obvious that there is unlimited value in the type of programs carried on in Texas under the auspices of the Texas State Department

of Health. There are other distinct evidences of the value of the programs which, owing to their nature, can hardly be shown by statistics and data. The flattering and enthusiastic reports from local dentists in the areas where the programs are in effect are in themselves conclusive that the programs are valuable. The expressions of appreciation from teachers, parents, county and city officials, public health circles and even from the children themselves are likewise convincing that the programs are well worth while.

The increase in the volume of dental service for children, in the local dentists' practices, and the improvement in the children's attitude as patients in the dental office are facts that cannot be disputed.

Let us hope, and we believe that we may, that, as time goes on, the results and benefits will be even more noticeable and convincing. Surely as the public becomes informed and is made aware of these possibilities, there will be an ever-growing demand for at least some type of dental health program in every community. Surely, if the people are made aware of the fact that of the selectees examined for military service, 21 per cent had dental disease that disqualified them, leading the field of physical causes of rejections, and that virtually all of it could have been prevented through education and correct dental habits, and at a very low cost, they will be activated to expend a reasonable amount for dental public health. Yes, dental health can be purchased at a reduced rate. Further studies and additional surveys will be made in other localities and in these points of the present study as time goes on.

If we were to compute the value of the program in Nueces County in terms of dollars and cents alone, the result would be dividends of many times the actual cost. For instance, if we have reduced the permanent tooth mortality rate from 26.4, and we believe it was even more than that, to 6.4, it means that, in the six years, we have saved twenty permanent teeth per hundred children. There are approximately 25,000 school children in Nueces County. Multiplying 250 by 20 gives a total of 5,000 permanent teeth saved. If this were multiplied by the average cost of replacing these teeth with bridgework, it would total a huge sum. And how much better and more conducive to dental health and general health is the healthy, natural tooth than any artificial restoration.

This, of course, does not take into account the numerous other benefits to the deciduous teeth, the health of the gums and the general oral hygiene.

THE RÔLE OF FLUORINE IN DENTAL HEALTH

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THE original epidemiologic studies carried out by McKay and Black in 1916[1] on the relationship of drinking water to mottled enamel were followed by surveys and studies carried on with the purpose of locating and modifying those water supplies showing sufficient fluorine to cause mottling of enamel.

About 400 areas in the United States were found to have sufficient fluorine in the drinking water to be classified as endemic areas. During this period, the statement was frequently found in dental literature that although the enamel of the teeth in endemic areas was hypoplastic, the teeth did not appear to decay any more rapidly or frequently than normal teeth.

During the past several years, a new clinical significance of fluorine in drinking water has been observed which may have a far-reaching effect in the control of dental caries. This observation is that, in regions where mottled enamel is endemic, there is considerably less dental caries. The report of Ainsworth in 1933[2] showed great reduction of dental decay due to fluorine in the water. Since then, the United States Public Health Service under the direction of H. T. Dean[3] has carried on studies which point to reduced dental decay as the result of ingestion of varying amounts of fluorine from water in widely scattered sections of the United States. One of the drawbacks to a study of the relationship of fluorine to dental decay is that it is difficult to get a sufficiently large sample of children in any one place in an endemic area who have a history of a continuous water supply, and, as a result, only a few hundred children in an area are reported in these studies. Naturally, the larger the sample in a given area, the more statistically significant the findings become. The purpose of this paper is not to review the literature on fluorine, which has been so ably done by many investigators, but to present further evidence as to the decrease in dental decay experienced by a large group of children (1,647) in one community having fluorine in the water supply.

In 1936, I conducted a survey of mottled enamel in Green Bay, Wis., a city of 45,000 population having 2.1 parts per million of fluorine in its water supply. This survey, which was carried out with the 12 to 14 age groups, considered only the severity of the mottled enamel. The statistics from that survey showed that the mottled enamel index there was about the same as for other communities in the United States having a like amount of fluorine (2.1 parts per million) in the drinking water.

About 1,600 children in Green Bay gave a history of a continuous water supply (being born and always residing in Green Bay). No dental caries experience tabulation was made at that time.

With reports coming from several sections of the country as to the decreased amount of dental decay encountered in endemic regions and the increased attention shown by the profession recently in the possible control of caries by fluorine ingestion, it was decided to undertake a dental caries study in Green Bay and to include a city of like population, Sheboygan, which has a

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practically fluorine-free water supply, as a control. These two cities are about 65 miles apart in the east central section of Wisconsin. Green Bay has a population of 46,000; Sheboygan, 41,000.

The water supply of Green Bay, during the formative stage of the teeth of the subjects covered in this survey, was obtained from five wells ranging in depth from 804 to 955 feet. The formations penetrated in all these wells consisted of Galena-Platteville limestone, St. Peter sandstone, lower magnesium limestone and Upper Cambrian formations. The fluoride content of the water from these wells ranges from 1.6 to 2.5 parts per million, with an average of approximately 2.1.

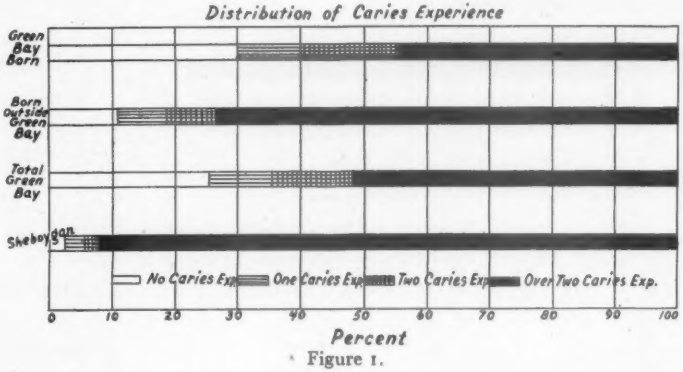

Figure 1.

Studies made in 1937 indicated that all of the formations penetrated by the wells produce water containing fluorine in excess of 1.3 parts per million. Therefore, children using water from private wells of shallow and variable depths, in adjacent rural areas, also had a water supply showing appreciable quantities of fluorine.

Sheboygan secures its water supply from Lake Michigan, the intake extending 5,000 feet from shore. Fluoride determinations of Lake Michigan water indicate a concentration of 0.05 parts per million. Analyses of samples from shallow and deep wells in the vicinity of Sheboygan indicate fluoride concentrations comparable to those of Lake Michigan water.

A comparative soil analysis of the counties in which these two cities are located shows the following: Brown County, in which Green Bay is located, has a soil acidity of 31 per cent, while Sheboygan County has 14 per cent. Brown County has a 52 per cent deficiency in phosphorus, while Sheboygan County has a 42 per cent deficiency. The soil acidity analysis shows a deficiency of lime. As can be seen from the foregoing, the area surrounding Green Bay is more deficient in both calcium and phosphorus than the area around Sheboygan. In spite of the greater deficiency in these elements, the dental conditions are better, as is shown by the accompanying charts.

In preparing the survey, an effort was made to include a breakdown of the caries encountered, in such a way that the final figures could be compared with the data for other cities where similar studies had been carried on. The following items were included: number of (1) teeth filled; (2) anterior teeth (six) filled; (3) anterior surfaces filled; (4) teeth carious; (5) anterior teeth carious; (6) anterior surfaces carious; (7) teeth extracted; (8) teeth needing extraction, and (9) first molars filled, carious,

extracted or in need of extraction.

As can be seen from the foregoing, this study was a record of caries experience of the teeth rather than of actual caries. A tooth that was both filled and carious was counted only once, and then as filled. A tooth was counted once whether it had one or several carious surfaces. The DMF rate was found by adding the number of filled teeth to the number of carious teeth plus the number of teeth extracted and dividing by the number of children examined.

The mottled enamel study was broken up into the following classifications: normal or questionable, very mild, mild, moderate and severe.

All the seventh, eighth and ninth grade pupils were examined in both the cities. The children in Green Bay were placed in two groups: (1) those born in Green Bay and who had maintained a continuous residence there and (2) those who were born outside or who had maintained residence outside for a period of time.

The examinations were exactly the same in the two cities, employing sharp-pointed explorers and mouth mirrors in the presence of good light. The few deciduous teeth remaining in the mouths of these children were ignored, all figures reported pertaining to permanent teeth only.

In Green Bay, 2,168 children (in the seventh, eighth and ninth grades) were examined, and, of this number, 1,647 gave a history of continuous use of Green Bay water. In Sheboygan, 1,877 school children (in the seventh, eighth and ninth grades) were examined.

A study of the tables and charts presented gives a graphic picture of the dental decay experience found in the

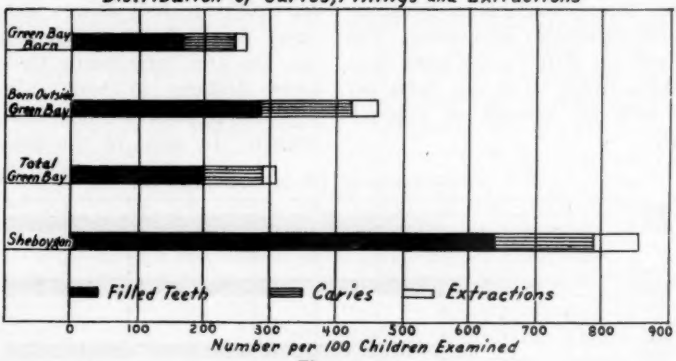

Figure 2.

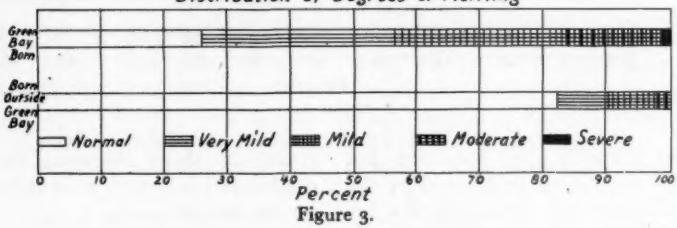

Figure 3.

two cities. There is not a single breakdown of dental caries experience that does not show a pronounced advantage in dental health to those children who have continuously used fluorine water. A close study of the accompanying charts will give a vivid picture of the dental health conditions in these two communities.

Only a few of the outstanding differences will be discussed.

Sheboygan DMF rate of 8.54. In Sheboygan, about twice as many first permanent molars have developed dental caries as in Green Bay. Approximately five times as many permanent teeth have been extracted in Sheboygan as in Green Bay. In Sheboygan, there is about fifteen times as much decay of the anterior teeth as in Green Bay and the children have had about four times as many fillings placed in their teeth as

TABLE 1.—SUMMARY OF DENTAL SURVEY OF CHILDREN BORN IN GREEN BAY*

	Total Number	Teeth Filled	Anterior Teeth Filled	Anterior Surfaces Filled	Carious Teeth	Anterior Carious Teeth	Anterior Surfaces Carious	Teeth Extracted	Teeth Needing Extraction	First Molars Filled	First Molars Carious	First Molars Extracted	First Molars Needing Extraction	DMF
Both sexes	1,647	2,729	104	105	1,343	107	122	236	65	2,125	817	179	74	2.62
Males	822	1,260	49	52	691	65	67	118	44	973	441	80	40	2.50
Females	825	1,469	55	53	652	42	55	118	21	1,152	376	99	34	2.71
7th grade	636	877	28	27	458	33	32	50	19	734	296	36	25	2.18
8th grade	569	937	32	33	427	49	50	101	18	721	283	72	26	2.57
9th grade	442	915	44	45	458	25	40	85	28	670	238	71	23	3.30
No caries experience	491	—	—	—	—	—	—	—	—	—	—	—	—	—
One caries experience	176	78	4	3	93	5	5	5	1	70	86	3	1	1.00
Two caries experiences	240	228	8	8	222	13	13	30	11	219	199	25	7	2.00
Two or less caries experiences	907	306	12	11	315	18	18	35	12	289	285	28	8	.72
More than two caries experiences	740	2,423	92	94	1,028	89	104	201	53	1,836	532	151	66	4.93

Percentages: No caries experience, 29.8; one caries experience, 10.7; two caries experiences, 14.6; two or less caries experiences, 55.1; more than two caries experiences, 44.9.

*Continuous water history.

In Green Bay, approximately 30 per cent of the children born and reared there have had no dental caries experience and 55 per cent of all the children have not had more than two experiences with dental caries. In Sheboygan, less than 3 per cent have had no caries experience and less than 8 per cent have had a caries experience of two or less. The DMF rate for the children born in Green Bay is 2.62 as compared with the

have the children living in Green Bay.

Table 2 shows the DMF rate for those children now residing in Green Bay, but born or reared elsewhere, to be 4.59, as compared with the 2.62 DMF rate for the children born and reared in Green Bay. While this rate is considerably higher than the rate for the children born in Green Bay, it is likewise much lower than the 8.54 DMF rate for Sheboygan. Undoubtedly the reason for the

comparatively low DMF rate of 4.59 is that many of these children had lived in rural areas surrounding Green Bay where even shallow wells contain considerable fluorine. Figure 4 shows that many of these children show mottling of the enamel to a moderate degree.

Fluorine cannot be looked upon as a panacea for all dental caries. Although the average child reared on water containing fluorine has a considerable degree of caries immunity, many get very little fluorine and often get objectionable mottling from drinking water containing it. This is best shown in children in one family in which one has considerable mottling of the enamel and several carious teeth, while another has no mottling of the enamel and no caries experience; or vice versa. Apparently it is not the mottling that results in the immunity to decay.

The only statistically significant figures we have at the present time are those that deal with people who have been on fluorine-containing water continuously since birth. What effects, if any, can be expected from the use of fluorine mouthwashes or topical applications of fluorine solutions to the teeth, future research will have to demonstrate. Certainly, to date, there is no evidence to prove any of the extravagant claims being made that fluorine holds the secret of all dental decay prevention. On the other hand, nothing has been demonstrated yet that equals fluorine in its ability to lessen dental caries in large groups over a long period of time. However, more research on the etiology of dental caries and the manner in which fluorine operates in the body to increase the resistance to dental caries will have to be carried out before fluorine can be safely offered to the

TABLE 2.—SUMMARY OF DENTAL SURVEY OF CHILDREN BORN OUTSIDE GREEN BAY*

	Total Number	Teeth Filled	Anterior Teeth Filled	Anterior Surfaces Filled	Carious Teeth	Anterior Carious Teeth	Anterior Surfaces Carious	Teeth Extracted	Teeth Needing Extraction	First Molars Filled	First Molars Carious	First Molars Extracted	First Molars Needing Extraction	DMF
Both sexes	521	1,472	112	123	732	95	99	187	58	977	372	144	72	4.59
Males	249	685	61	67	342	45	46	63	26	472	184	47	31	4.38
Females	272	787	51	56	390	50	53	124	32	505	188	97	41	4.78
7th grade	174	340	17	19	221	27	27	47	20	294	140	35	21	3.49
8th grade	158	456	32	34	238	26	26	51	21	289	112	44	26	4.72
9th grade	189	676	63	70	273	42	46	89	17	394	120	65	25	5.49
No caries experience	57	—	—	—	—	—	—	—	—	—	—	—	—	—
One caries experience	40	23	1	1	16	—	—	1	—	23	13	—	—	1.00
Two caries experiences	40	43	—	—	34	2	2	3	2	41	27	3	2	2.00
Two or less caries experiences	137	66	1	1	50	2	2	4	2	64	40	3	2	.88
More than two caries experiences	384	1,406	111	122	682	93	97	183	56	913	332	141	70	5.91

Percentages: No caries experience, 10.9; one caries experience, 7.7; two caries experiences, 7.7; two or less caries experiences, 26.3; more than two caries experiences, 73.7.

*Non-continuous water history.

profession and the public as a means of caries prevention.

Recently, both in dental literature[4] and the press, articles have appeared suggesting that fluorine be added to drinking water to prevent dental caries. It seems to me that this suggestion is premature, for several reasons: first, that the dental benefits from fluorine in drinking water have not been clearly and conclusively presented to the dental profession. Of the 400 areas in the United States having considerable amounts of fluorine in the water supply, only a few have been surveyed as to the dental caries experience. Reports on a survey of 100 or 200 in an area may show a trend, but cannot be accepted by the profession and the public as definite proof of the ability of fluorine to reduce dental decay.

The total number of all surveys in the United States up to this time as to the amount of decay to be found in endemic areas would be only a few thousand. These have all been made on children of 14 years or younger in scattered areas. Before we can entertain any hopes of convincing the dental profession of the true value of fluorine in reducing dental caries, we must present evidence that is more statistically significant. The surveys will have to show the profession that hundreds of thousands of people, not hundreds or thousands, have had a greatly reduced caries rate in endemic areas. Likewise, the surveys should include those up to at least 18 years of

TABLE 3.—MOTTLED ENAMEL IN CHILDREN BORN IN GREEN BAY*

	Total Number	Normal	Very Mild	Mild	Moderate	Severe
Both sexes	1,647	428	506	443	248	22
Males	822	227	258	204	117	16
Females	825	201	248	239	131	6
7th grade	636	195	177	156	100	8
8th grade	569	140	185	157	79	8
9th grade	442	93	144	130	69	6
No caries experience	491	148	154	125	64	—
One caries experience	176	40	61	46	26	3
Two caries experiences	240	54	73	77	33	3
Two or less caries experiences	907	242	288	248	123	6
More than two caries experiences	740	186	218	195	125	16

*Continuous water history.

TABLE 4.—MOTTLED ENAMEL IN CHILDREN BORN OUTSIDE GREEN BAY*

	Total Number	Normal	Very Mild	Mild	Moderate	Severe
Both sexes	521	429	43	37	12	—
Males	249	210	20	13	6	—
Females	272	219	23	24	6	—
No caries experience	57	49	4	4	—	—
One caries experience	40	26	10	2	2	—
Two caries experiences	40	28	3	9	—	—
Two or less caries experiences	137	103	17	15	2	—
More than two caries experiences	384	326	26	22	10	—

*Non-continuous water history.

age, which would mean the high school group. This higher age group should present a more impressive picture of the ability of fluorine to inhibit caries than the younger age group. These surveys must be carried on in like manner in each area so that the data will be comparable. Such surveys would likewise show the lowest level of fluorine that would afford a relatively high degree of caries immunity. Here is an opportunity at first hand the low incidence of decay associated with it, and are convinced that the addition of fluorine to drinking water offers possibilities of reducing dental decay to a greater extent than any other single measure. It has the advantage of being time-tested and lends itself to use as a public health measure. Unfortunately, the rank and file of the dental profession have not to date been presented with sufficient evidence to justify them in reaching the same conclusion.

TABLE 5.—SUMMARY OF DENTAL SURVEY IN SHEBOYGAN

	Total Number	Teeth Filled	Anterior Teeth Filled	Anterior Surfaces Filled	Carious Teeth	Anterior Teeth Carious	Anterior Surfaces Carious	Teeth Extracted	Teeth Needing Extraction	First Molars Filled	First Molars Carious	First Molars Extracted	First Molars Needing Extraction	DMF
Both sexes	1,877	11,993	2,292	2,699	2,754	853	962	1,287	206	5,139	510	1,054	196	8.54
Males	899	5,159	871	1,010	1,402	443	499	667	103	2,299	283	543	103	8.04
Females	978	6,834	1,421	1,689	1,352	410	463	620	103	2,840	227	511	93	9.00
7th grade	586	2,897	425	492	794	295	336	333	68	1,524	178	299	67	6.87
8th grade	629	3,996	786	927	909	272	315	463	66	1,790	178	357	64	8.53
9th grade	662	5,100	1,081	1,280	1,051	286	311	491	72	1,825	154	398	65	10.03
No caries experience	52	—	—	—	—	—	—	—	—	—	—	—	—	—
One caries experience	44	22	1	1	19	1	1	3	—	25	13	2	—	1.00
Two caries experiences	53	60	2	2	36	1	1	10	2	56	23	10	2	2.00
Two or less caries experiences	149	82	3	3	55	2	2	13	2	81	36	12	2	1.01
More than two caries experiences	1,728	11,911	2,289	2,696	2,699	851	960	1,274	204	5,058	474	1,042	194	9.19

Percentages: No caries experience, 2.77; one caries experience, 2.34; two caries experiences, 2.82; two or less caries experiences, 7.93; more than two caries experiences, 92.07.

for the American Dental Association, the United States Public Health Service and the state boards or departments of health to cooperate in outlining the procedure for these surveys; sponsoring them, tabulating the findings and making the information available to the profession and the public.

The few men who have carried on investigations as to the caries experience found in those who have continuously used fluorine-containing water have seen

When sufficient evidence has been presented to the profession for them to accept all the claims now made for fluorine, it will be no easy matter to put that knowledge into practice. Much in the way of public education and education of official bodies will have to be done before fluorine can be added to the diets of our children. Such public health measures as pasteurization of milk,

chlorination of water and the iodizing of salt did not come about overnight. In fact, many communities have not yet availed themselves of these proved public health measures. All new public health measures required a mass of favorable data and experience before they could be introduced generally. We of the dental profession have the obligation of collecting all the data that it is humanly possible to gather on the relationship of fluorine to dental decay, and when that is done, and if the findings prove favorable, we can take the steps necessary to have that knowledge so applied that it will benefit the public to the greatest extent. This may mean the addition of fluorine to water supplies or to certain generally used foods, such as milk. No toxic effect, except mottling of the enamel, has been reported from the use of water containing 2 parts per million of fluorine.

It must be remembered that the fluorine found in water in 1 to 1.5 parts per million, which is as high a concentration as possible without causing disfiguring mottling of the enamel, is not a cureall for dental decay. Even where 2 parts per million of fluorine is present, as the preceding tables show, the children 12 to 14 years old show a DMF rate of 2.62. While this is much lower than the DMF rate of 8.54 in the fluorine-free area of Sheboygan, there is also considerable objectionable mottling of the teeth in Green Bay. (Table 3.) Undoubtedly, the highest concentration of fluorine permissible would be below 1.5 parts per million and, with such a concentration, the DMF rate would probably be somewhat higher. There is a possibility that 1 part per million may be enough to confer a relatively high immunity to dental decay.

Recently, some work has been done on

TABLE 6.—SUMMARY OF COMPLETE DENTAL SURVEY

	Total Number	Teeth Filled	Anterior Teeth Filled	Anterior Surfaces Filled	Carious Teeth	Anterior Teeth Carious	Anterior Surfaces Carious	Teeth Extracted	Teeth Needing Extraction	First Molars Filled	First Molars Carious	First Molars Extracted	First Molars Needing Extraction	DMF
Green Bay	1,647	2,729	104	105	1,343	107	122	236	65	2,125	817	179	74	2.62
Outside Green Bay	521	1,472	112	123	732	95	99	187	58	977	372	144	72	4.59
Total Green Bay	2,168	4,201	216	228	2,075	202	221	423	123	3,102	1,189	323	146	3.06
Sheboygan	1,877	11,993	2,292	2,699	2,754	853	962	1,287	206	5,139	510	1,054	196	8.54

TABLE 7.—PERCENTAGES

Area	Total Number	No Caries Experience	One Caries Experience	Two Caries Experiences	Two or Less Caries Experiences	Over Two Caries Experiences
Green Bay	1,647	29.8	10.7	14.6	55.1	44.9
Outside Green Bay	521	10.9	7.7	7.7	26.3	73.7
Total Green Bay	2,168	25.3	10.0	12.9	48.2	51.8
Sheboygan	1,877	2.77	2.34	2.82	7.93	92.07

the topical application of fluorine to the enamel surfaces of teeth.[5, 6] While the investigators have only made preliminary reports on a few cases, further research may show that this procedure has merit. It did appear to me that children who begin to use a domestic water supply containing fluorine several years after the crowns of the permanent teeth had been formed obtained a degree of immunity. However, the figures shown in Table 2 are not conclusive, as it was difficult to obtain a complete water history and many gave evidence of mottled enamel (Table 4), indicating that fluorine was present in the water supply where they were born and reared. As was mentioned earlier in this paper, shallow-well water in rural areas surrounding Green Bay contains varying amounts of fluorine, and many of the children listed in Table 2 as born outside Green Bay come from these areas.

To date, the only statistically significant data that we have in relation to fluorine and dental decay are on those who were born, and maintained continuous residence, in an endemic area. Whether the fluorine in the water is operative by being incorporated into the enamel itself during the formative period, or by some enzyme or endocrine action or its effect on the bacterial flora of the mouth, remains for research to determine. We do know that the dental

TABLE 8.—FIRST MOLARS (SUMMARY)

Area	Number of Children	First Molars Filled	First Molars Carious	First Molars Extracted	Total	Total per Hundred Examined
Green Bay	1,647	2,125	817	179	3,121	189.50
Outside Green Bay	521	977	372	144	1,493	286.56
Total Green Bay	2,168	3,102	1,189	323	3,614	212.82
Sheboygan	1,877	5,139	510	1,054	6,703	375.11

TABLE 9.—ANTERIOR SURFACES (SUMMARY)

Area	Number of Children	Anterior Teeth Filled	Anterior Surfaces Filled	Anterior Teeth Carious	Anterior Surfaces Carious	Total Surfaces Carious or Filled	Total Surfaces Carious or Filled per Hundred Examined
Green Bay	1,647	104	105	107	122	227	13.78
Outside Green Bay	521	112	123	95	99	222	42.61
Total Green Bay	2,168	216	228	202	221	449	20.71
Sheboygan	1,877	2,292	2,699	853	962	3,661	195.05

TABLE 10.—DMF SUMMARY

Area	Number of Children	Teeth Carious	Teeth Filled	Teeth Extracted	DMF
Green Bay	1,647	1,343	2,729	236	2.62
Outside Green Bay	521	732	1,472	187	4.59
Total Green Bay	2,168	2,075	4,201	423	3.06
Sheboygan	1,877	2,754	11,993	1,287	8.54

caries experience is greatly lessened in those who have continuously used fluorine-containing water since birth.

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POST-WAR ADJUSTMENTS

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I SHALL attempt to discuss rather briefly the post-war adjustments as they might affect the individual before considering some of the problems which the profession as a whole should be facing. It would be absurd to attempt to predict what the future will bring to any one individual, but there are certain predictions in limited fields which logically can be made. With the extra burdens which all of us are carrying, it is difficult for us to detach ourselves momentarily and take a long-range look at what is happening.

It is deemed essential in this modern total war that all the people must be jarred into a war psychosis. There are always dissenters to war, to all war, and to any war in particular. This was as true in the time of George Washington and Abraham Lincoln as it is today. If winning the war means that all of us have to be in there pitching all the time, then all else must be subordinated to the war. In addition to the individual's direct contact with the war, all of us are being constantly reminded of it by the radio and the press, and all the little commonplaces of our lives are being constantly altered and restricted. These continual annoyances and harassments eventually produce a sense of irritable frustration and we have difficulty in keeping our feet on the ground.

Dentists are fundamentally individualists. We have to be. In our professional lives most of us are responsible only to ourselves. We have to make our own diagnoses and we carry out our own treatments, and, of course, decide all the other details of conducting a profession and a business. That all of us here have been able to do this successfully is self-evident. If we had not been right more often than we were wrong, we would not still be practicing dentistry. You and I have solved the problems as they came along, and we have done all right so far. We can do it the rest of the way.

After this present super-boom is over, we can be sure that we and our patients are going to have to pay more in taxes and have less to spend for other things for a long time to come. There will be many dentists, now in the armed forces, returning to civil life and trying to build or rebuild a practice. There will be a

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reshuffling of populations as war workers and ex-soldiers have to turn to other pursuits. There will be a great deal of dentistry needed but it will take time to get all our professional affairs arranged again. Consider those as a few symptoms and make your own diagnosis.

Now what about the profession as a whole?

As far as the profession of dentistry is concerned, this is just another war. It's a bigger and a better one. Last time it was the war to end wars; this time it is for the Four Freedoms. But some good came out of the last war and more can come out of this one if we will remember some of the lessons of the last war, and do a little planning. Unfortunately, those men who run the war also plan the peace, and the type of mind which conducts a successful war is not always the type to plan a successful reconstruction. A detached and scientific viewpoint can formulate plans, and if these plans are trimmed to fit human values, we can gain a little more out of this war than is usually the case.

I do not agree with those in our government who feel that it is our bounden duty to look after the entire world. We paid for a large part of the last war and for the reconstruction of Europe afterward, and I do not think we have much to show for our efforts. However, as dentists we do have a definite obligation to the world as a scientific body, and it is peculiarly our own.

For several generations, American dentistry has been the best in the world. This is true of no other profession. American medicine may be attaining that goal, but of engineering, law or architecture the same cannot be said. Such an assumption of leadership has two connotations: Are we in any danger of abandoning those fundamental principles which were responsible for our leadership, and are we assuming the obligations to the rest of the world that we should assume?

Let us consider the rest of the world first. The havoc on civil populations of famine and disease means that both the present and oncoming generations will need a great deal of dental care for a long time. Dental schools, dental clinics and the offices of the practitioners have been destroyed, to say nothing of the dentists themselves. What should we be doing? One scientific society to which I belong has had its entire journal microfilmed, and I think it is the only one which has done so. With selected dental literature so treated, it would be possible to furnish a dental library to any part of the world at a small cost.

We shall have a tremendous quantity of Army dental supplies left after the war, and we all know that the dental trade will never allow it to be dumped on the American market, and I think justly so. Should it rust and rot away in warehouses or should it do some one some good? There will be some dentists discharged from the Army who might have the ability and the inclination to live abroad, and there are many refugee dentists who might well be assisted in returning to their native lands and rebuilding their practices.

Let us take a look at our local scene. We should realize that some form of socialized dentistry is inevitable. There is certainly a growing sentiment that the world's goods might be better distributed and this will blossom full-blown after the war ends. Add to this the large voting segment of the population that has been taught for the last ten years that they should have something for nothing. Add to that the number of dentists who have been lifted from their practices and placed in jobs where they could press buttons and issue directives.

Now, instead of going into a corner and getting a case of the horrors when socialized dentistry is mentioned, let us consider how simple it may be to work out a scheme that might do a lot of good and very little harm.

To begin with, we all know that all of

us could work all the time and still not take care of the dental needs of this country. We all know that good dentistry is an expensive luxury *per se*. It takes a lot of first-class surgical skill, a lot of expensive equipment and a lot of time. No dentist can adequately treat the same number of patients as a physician.

We are confronted with a group of very articulate social planners who feel very competent to solve all the modern and all the age-old problems of humanity.

Most of us were educated in a time when it was considered that science and logic could find the answer to anything. We were taught that the theory of cause and effect was an immutable law. Modern science now knows that the laws of probability and uncertainty have pitched the old dogma of cause and effect out of the window. Unfortunately, the so-called social sciences have seized these outworn tags and symbols and have tried to apply them to human behavior. We are going to have to realize that common sense and intuition are better guides for human behavior than the theoretical economic man who uses one pound of coffee, two cans of beans, two pounds of sugar, and sixteen gallons of gasoline every month.

All socialized schemes founder because some of their tenets are fallacious. One is, that all should share alike. There are always malcontents. Even if a condition were good, they would not like it. We all know that there are lots of people who want nothing to do with dentists or dentistry at any price. From a realistic point of view, we should leave them out of any scheme except as we wish to waste money trying to educate them. The second big stumbling block is that if we get something for nothing, both sides get cheated, for in the long run we get about what we pay for.

How can we coordinate these things into a workable proposition? Certainly we are going to have to continue to make some provision for the chronically underprivileged. We must consider those who want to pay a little, but cannot pay much, and we want to continue to take care of those who are coming along in the world and who want to be able to get the better and the best service.

If we are to furnish dental service to the underpriviliged, it should be rendered by those of limited capabilities and who can afford to give such service for the sake of experience. This obviously means that the ordinary type of clinic service with which we are all familiar could be expanded into a public health service with students on an intern's salary, as part of their education. The recent graduate could be fitted into an extension of such service for part-pay patients on a rising salary over a span of years to continue to gain experience, either for general practice or with a view to specialization. Those who preferred the security of a salaried job could stay on as supervisors or as panel dentists.

Thus, by merely integrating already existing institutions, namely, the schools, the existing local health clinics and the public health service, it would be possible to render charity and low cost dental service to those who wish and who may deserve it by the efforts of those whose talents are also limited, and at the same time preserve the healthful stimulation of free enterprise and increased compensation for superior service.

908 Beaumont Medical Building

ORAL DIAGNOSIS

B. B. McCollum, D.D.S., Los Angeles, Calif.

INTRODUCTION

THE exacting conditions placed upon dentists in their care of the mouth is not exceeded by any other specialty of health service. So far, immunity against dental and parodontal diseases remains much of a mystery. Thus, on one hand, we know not how to establish or fortify immunity and, on the other hand, the dental tissues will not automatically heal themselves. Dentists have a hard task in guarding the health of the mouth, and a harder task in repairing it. To a great extent, they must work in the darkness of the unknown. Yet, the oral organ we guard is important. Its integrity and wholesomeness are important and indispensable to health. No human body can be deemed healthy without a healthy, properly functioning oral organ.

TOOTH DIAGNOSIS TOO LIMITED

So far as restorative dentistry is concerned, the beacons of research are illuminating this field of darkness. There is already available knowledge enough, if we will use our knowledge to restore the teeth to better function so that they will chew well, work harmoniously with each other and thereby promote the health of the gums and their substructures. For a long time we have had access to anatomic knowledge, but little has been done to connect this knowledge with oral physiology. Anatomy without physiology is like knowing the names of the parts of a machine without knowing their use.

We have technical training and we have the implements to apply dental remedies. What we lack and have long lacked is the ability to use anatomic and physiologic knowledge in diagnosis. We have limited our application of knowledge to too small a field—to the teeth and their immediate investing tissues. We have been content to observe the forms of the teeth and try to imitate their likenesses and have failed to understand their anatomy and purpose. We have failed to understand the passive rôle that teeth play in oral physiology. Teeth are but instruments of function. This passive rôle in no way makes the teeth less important, but does demand a better understanding of the mechanism by means of which their purpose is fulfilled.

We have limited our diagnostic efforts to local "trouble shooting." We have counted cavities, charted them, roentgenographed them and found opportunities to apply simple dental remedies to combat caries. Or we have noted and counted spaces between teeth to be bridged and called that diagnosis. We have discovered pus pockets and "dead teeth," things easy to identify, and called this professional diagnosis. The x-rays and the pulp testers have disclosed apical and other bone diseases and we have called that diagnosis. We have made our diagnostic procedures so simple and so easy that the office assistant is quite as competent in identifying opportunities for dental work as the dentist. Even the patient often takes a hand in the conclusions. All this may be tooth diagnosis, but it certainly is not oral diagnosis. The application of the simplest dental remedies needs oral diagnosis as the basis of their application if dental treatment is ever to be generally improved.

Read before the Southern California State Dental Association.

WHAT IS A DIAGNOSIS?

Dental diagnosis must be based upon a usable understanding of the anatomy and physiology of the oral organ. Dentists must be able figuratively to take the oral organ apart and put it back together, if they are to make successful oral diagnoses; for all that diagnosis can ever be is based on knowing an organ or a machine so well that one can tell what is right and what is wrong with it. If the dentist can determine what works well and as clearly what works poorly, he can make an oral diagnosis. But we cannot do that with a machine or with a biologic mechanism, unless we know how each is made and how it should work. The gasoline engine repairman must know how to disassemble and reassemble an engine, if he is to repair it well. He must know how to grind the piston rings and the valves; how to adjust the timing; how to put in the bearings, how to adjust the sparks, and everything else that contributes to a smooth, silently running engine.

A heart specialist is just as mechanical in his diagnosis. He must know how the heart is formed, what kind of valves it has, what sort of chambers it has and what sort of a sac it hangs in. He must know how it receives the blood and how it expels it into the aorta. He counts the beat; he notes the rhythm; he analyzes the timing of the auricles and the ventricles; he listens for the valve action and the tension of the heart walls. He must know figuratively how to take the heart apart and how to put it back together. Heretofore, he has made most of the corrections by resting or exercising the patient or by prescribing drugs that specifically affect the heart. Heart surgery, which has appeared lately, has astounded the medical world by its daring surgical attempts at treatment of heart defects. Dentistry can analyze the mechanics of the oral organ and maintain it or restore it to orderly function to a much greater degree than heretofore. This analysis will depend on an anatomic and physiologic understanding; the ability to know how the oral organ is formed and how it should work.

MOTIONS AND MUSCLES

If the dentist is to understand oral physiology, he must understand the actions of the joints and the muscles that operate the mandible. How the muscles and joints make the mandibular motions is the primary and, no doubt, the dominant part of oral physiology. It is true that the dentist seldom needs to directly treat the muscles, but dental remedies have to comply with what the muscles, through the joints, demand in fulfilling the oral functions. The various muscles attached to the mandible motivate it in all its directions. The action of certain muscles upon the mandible opens the mouth; that of others closes it. Certain muscles pull the mandible sidewise. A special pair of muscles pull the hinge of the mandible forward to produce the lateral movements and to augment the wide-opening movements, as well as to make the purely protrusive movement. Certain muscles pull the mandible backward into neutral. The muscles move the jaw in definite ways and rhythmically. Since the mandible, guided by the joints, makes definite motions in chewing, the teeth must be alined and opposed so that they can cooperate with these motions. And it is the function of dentistry to ascertain by diagnostic means all or any involvements of the mandibular joints and muscles due to a conflict of the teeth with these muscles and joints. If the dentist is to detect a lack of harmony between the teeth and muscles or between muscles and tooth arrangement, he must know what the physiologic requirements are.

MUSCLES OF MASTICATION

Let us review, in a very simple way, the anatomy and the action of the muscles of mastication. There are four

pairs of these power muscles: the temporal, the masseter, the external pterygoid and the internal pterygoid. Each pair specializes in some one or more motions, and I may say that they are no harder to understand than the cables or engines that operate a steam shovel.

THE TEMPORAL MUSCLE

The mightiest of the muscles of mastication is the temporal, an enormous head muscle that occupies the temporal fossa. (Fig. 1.) It is attached to most of the side bones of the cranium. More than that, some of its fibers are attached to the great flat cap tendon of the skull, so that it derives anchorage from the top of the head. When both temporal muscles contract and relax alternately, a pulsation can be detected in this tendinous cap that crowns the head. Moreover, this cap can be compared to a saddle bag that lies astride the head, carrying on each side in its sheaths the great bellies of the temporal muscles. This bag not only carries the temporal load, but also descends to the zygomatic arch, to which it is attached, to act as a suspending brace to that relatively small arch of bone. The fibers of the temporal muscle converge into a tendon that is attached to the inner side of the coronoid process of the mandible. Since the posterior fibers run at a forward angle to the ramus, when they contract they retrude the jaw. Since the middle fibers run more nearly vertically, their contraction raises the mandible. Since the anterior fibers run backward, they are said to be protruders of the mandible. When all the fibers of the temporal muscle contract together, they close the

Fig. 1.—The temporal muscle.

mandible. They can elevate the mandible when the jaw is in any degree of protrusion, because, in full protrusion, the anterior fibers are pulling vertically. This muscle is so made in fiber arrangements that it can close the mandible under any circumstances. Because of this, no trustworthy diagnosis of the centric position of the mandible can be made by palpating the pulsating temporal muscles. The anterior, middle and posterior fibers of this muscle can pulsate in any protrusive position of the mandible.

THE MASSETER MUSCLE

The masseter muscle arises from two heads, a superficial portion and a deeper portion of fibers constituting the muscle. (Fig. 2.) The superficial portion arises from a sinew attachment to the maxillary bone and also from a muscular attachment to the zygomatic arch. Its fibers run downward and backward

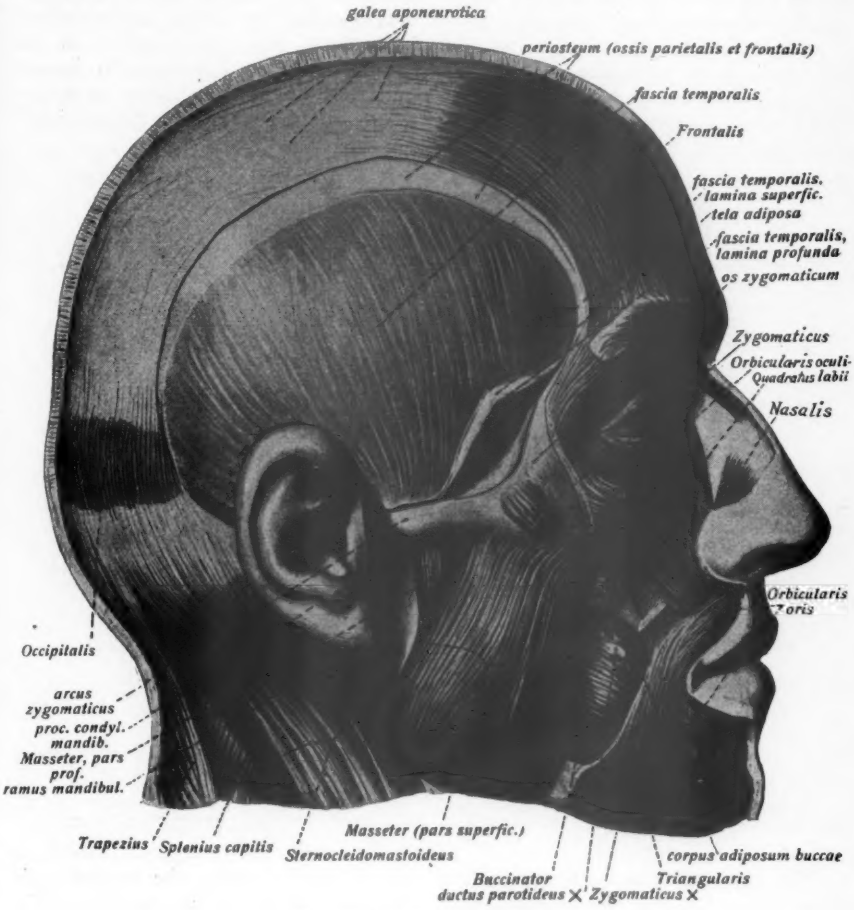

Fig. 2.—The masseter muscle.

to insert themselves in the angle and lower half of the ramus. The deep portion of the masseter arises from the zygomatic arch. Its fibers run downward and forward. The superficial portion of the masseter is said to be elevating and protrusive in action. The deeper portion is said to be elevating and retrusive, but the arrangement of these fibers provides for elevating the mandible also in any position of protrusion. Again, let me say, you cannot determine centric mandibular position by palpating the masseter muscle.

serted on the outer surface of the mandible. Thus, simultaneous contraction of the two does not rock or unstabilize the mandible.

THE PTERYGOID MUSCLES

The external and internal pterygoids are the lateral engines of the mandible. They produce the lateral motions of the jaw. Since the lateral actions of the mandible are so important in human oral function, it is necessary to understand well the actions of the pterygoid muscles.

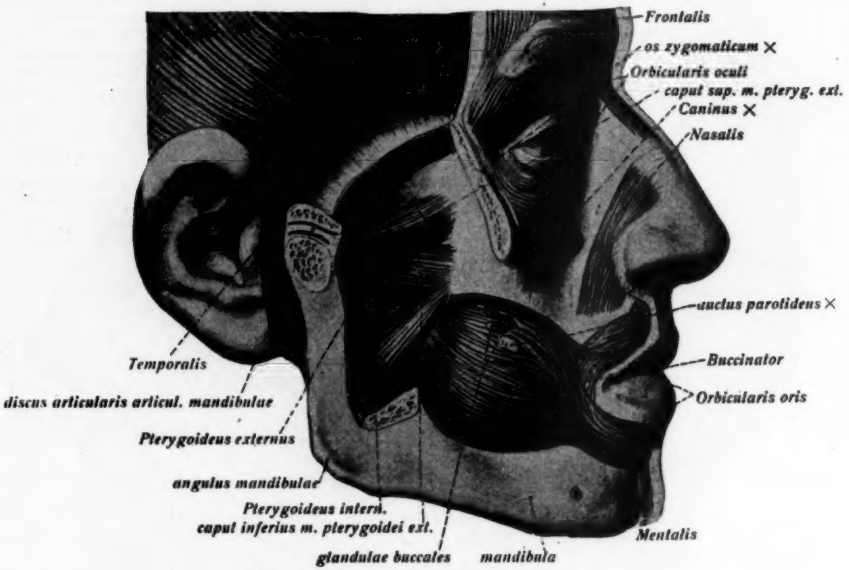

Fig. 3.—The external pterygoid muscle.

ACTIONS OF THE MASSETER AND TEMPORAL MUSCLES

The temporal and masseter muscles specialize in closing the mandible and retruding it. They do not participate in making the lateral movements of the mandible. They are partners in action. The temporal is attached at the top of the ramus and the masseter at the bottom. The temporal muscle is inserted on the inner surface; the masseter is in-

THE EXTERNAL PTERYGOID MUSCLE

The external pterygoid muscle is deeply hidden under the temporal and occupies the infratemporal fossa. (Fig. 3.) It has two heads, one arising from the great wing of the sphenoid and the other from the outer surface of the pterygoid plate. It is inserted in the neck of the condyle and the anterior border of the meniscus. It is a horizontal muscle. When it contracts, it pulls the

condyle directly forward and the meniscus along with it. It is a joint muscle. It does not pull the joint out of its socket, but makes the joint fulfil its purpose in the various protrusive and lateral movements. It guides the fulcrum of the jaw. It is the main protruder of the mandible. It does not open the mandible. Its pulling of the joints forward, so that a wide opening can be made without the angles of the jaw being cast too hard against the tissues behind it, has confused many dentists and anatomists in their conception of its actions. It should not take more than a close analysis of the direction of the pull of the muscle and its place of attachment to the meniscus and head of the condyle to reveal the true function of this muscle.

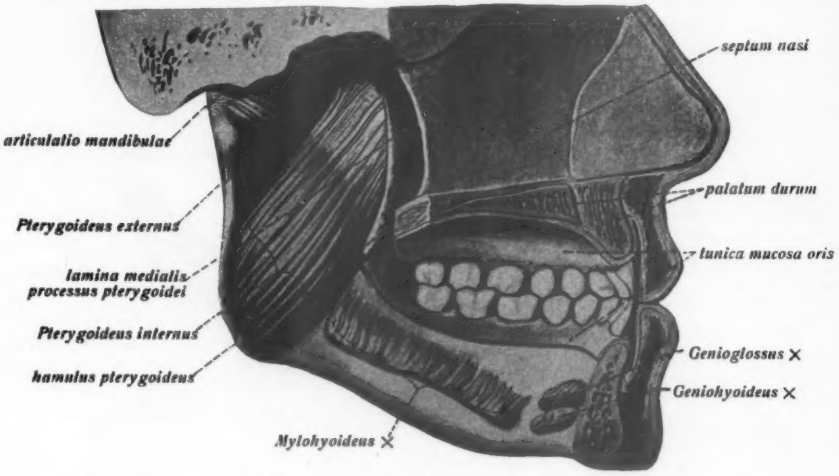

Fig. 4.—The internal pterygoid muscle.

RECIPROCAL ACTION OF THE TWO EXTERNAL PTERYGOIDS

If the external pterygoid on one side of the head contracts and the one on the other side remains lax, the mandible will be moved into a lateral position. As it relaxes, the posterior temporal fibers pull the joint back into neutral. Then if the opposite external pterygoid contracts, the mandible is moved to the opposite side. Strictly speaking, the external pterygoid is not a chewing muscle: It merely sets the mandible into position for chewing. It cannot close the jaws or retract the mandible. It thrusts the mandible forward, so that an incision can be made with the incisor teeth by the masseter and the temporal muscles; or it can put the mandible into a lateral position so that these same muscles can chew with the molars and bicuspids. It guides the mandible into lateral position and holds it steady while the individual is biting in the lateral position. It makes the guiding certain by its commanding influence upon the condyle and its movable fulcrum, the articular disk.

THE INTERNAL PTERYGOID MUSCLE

The internal pterygoid muscle, as the name indicates, is medially from the external pterygoid. (Fig. 4.) Like the external, it has two sources: the palatine bone and the maxilla, and the internal surface of the pterygoid plate. Its fibers run downward, backward and laterally to be inserted in the lower part of

the inner surface of the ramus and the angle. We who have made mandibular nerve blocks know that this muscle is inserted below the mandibular foramen. Since its fibers run laterally, when they contract on one side of the face, and the fibers of its opponent remain lax, they draw the back part of the mandible laterally. Since its fibers also run downward and backward, its contraction may help to protrude and elevate the mandible. Like the temporal and masseter muscles, it can close the mandible. Since lateral biting requires a forward movement of the condyle on the opposite side, the internal is a direct assistant of the external pterygoid. The external moves the condyle forward; the internal on the opposite side moves the body of the mandible sidewise. It helps the forward moving condyle to glide against the inner surface of the temporal fossa. If the inner curbing of the temporal fossa is turned inward more than a simple rotation of the opposite condyle can accommodate, the rotating condyle must move outward. Thus, we have explained anatomically the Bennett movement, or the sideshift of the mandible.

THE SYSTEM OF MUSCULAR ANTAGONISM

Skeletal muscles are usually arranged about a bone in sets of antagonists. A muscle is arranged to pull a bone in a given direction and another muscle is arranged to oppose and reverse the direction. One may flex a joint, the other will extend it. The antagonism in the muscles of mastication is quite simple. The posterior fibers of the temporal muscle retrude the mandible in opposition to the protruding action of the external pterygoid. The posterior fibers of the temporal are also antagonized by its anterior fibers, by the superficial portion of the masseter and, to some extent, by the internal pterygoid. The lateral components of the internal pterygoids are antagonists. The right internal pterygoid pulls the mandible leftward; the left internal pterygoid pulls it rightward. In other words, it is an antagonism that crosses the median line operating a bone that also crosses the median line of the body.

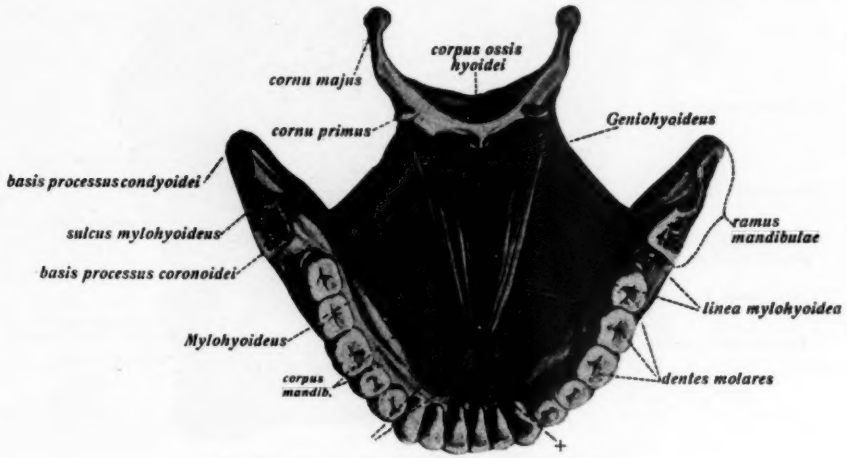

Fig. 5.—The suprahyoid and infrahyoid muscles.

The suprahyoid and infrahyoid muscles antagonize the closing components of the muscles of mastication. (Fig. 5.) The anterior throat muscles can also

retract the mandible. The geniohyoid is the muscle best placed to be given credit for opening the mouth. (Fig. 6.) Gravity also plays a part. The digastric, the omohyoid and the extrinsic muscles of the tongue and the floor of the mouth also engage in opening and retrusion. The mylohyoid is often given credit for tion, the left suprahyoids and the left digastric may assist the action. In the snarling bite, the buccinator and even the platysma give some assistance.

THE MORPHOLOGY OF THE TEMPOROMANDIBULAR JOINT

The form of the temporomandibular

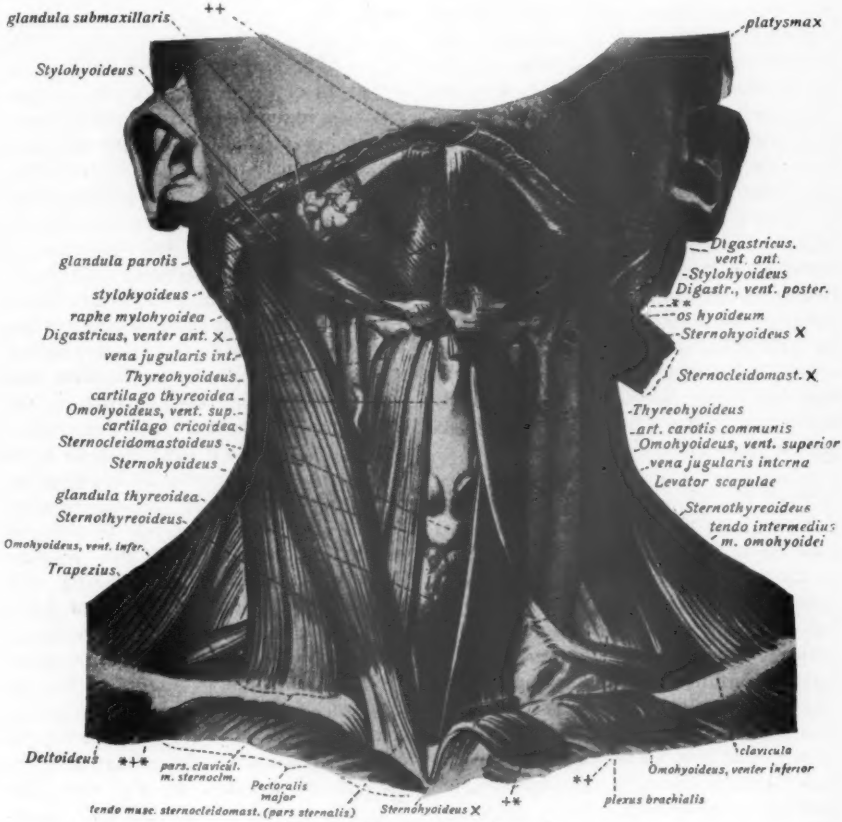

Fig. 6.—The geniohyoid muscle.

displacing a lower denture. It forms the floor of the mouth and can contract only downward, which it does to form a solid base for the operation of the intrinsic muscles of the tongue.

If the right pterygoids engage in throwing the jaw into left lateral posi-

joints has long been known. Their morphologic description is in every anatomy textbook. The temporomandibular joint is interesting to the morphologists because it is a double joint, consisting of two synovial compartments separated by an articular disk—the meniscus. The

ligaments of the joint, which have long been known, consist principally of the capsular and temporomandibular ligaments.

THE ANATOMY AND THE PHYSIOLOGY OF THE TEMPOROMANDIBULAR JOINT

The anatomy and the physiology of the temporomandibular articulation have only recently been understood. These important joints, which suspend the mandible and about which the muscles of mastication play like men at the rim of a wheel, have given up the secrets of their controls and importance very slowly. From about 1822 to 1870, Balkwill's observations of the gross movements of the jaw rested forgotten in the archives of a London library. Balkwill saw that the mandible opened and closed on an axis that runs through the condyles, that the condyles move downward and forward in protrusion and that the mandible moves bodily from side to side. Without knowing about Balkwill's work, Bennett demonstrated that the mandibular joints permit these three kinds of movement.

FORMER MISCONCEPTIONS OF THE JOINTS

There have been many misconceptions concerning the action and importance of the mandibular joints. The profession, in following the work of Gysi, was led to believe that the hinge axis described in Gray's old anatomy was of little importance; that the same patient would make different path tracings and would not make the same tracings constantly, and that, while the mandible did make bodily sideshifts, it was impracticable to determine them clinically. These unfortunate conclusions of Gysi added much confusion to the diagnostic thinking in dentistry and delayed the disclosure of the true physiologic importance of the condyles. To the confusion were added the wishful claims of leaders in dentistry that we could pay virtually no attention to these joints, because they were indefinite and slipshod in their movements—something never claimed about any other joint in the body. Gysi's conclusions also gave rise to the claims that the joints were subject to the whims of the muscles; that they were floaters, having no demands of their own; that they did not guide mandibular motions, and that they could be compelled to accommodate themselves to arbitrarily set teeth.

THE PRECISION OF THE JOINT

But all of this is not true. It is error. For one individual, the condylar movements are constant. He can and does make identical tracings of his condylar movements. It can be easily shown that the mandible has a definite opening and closing axis. It can be demonstrated that the individual condyle path has a definite inclination and curvature. It can be shown that the rotating condyle has a definite locus of action.[1] It is interesting to note that the inclination and curvature of the condyle path is not necessarily the same for the two sides of the individual. It is interesting to know that the loci of the rotating condyles are not symmetrical. The lateral rotation locus of the right condyle is not correspondingly spaced to the rotation locus of the left condyle. And why should we expect these particular joints of the body to be bilaterally symmetrical, when the halves of the body throughout are more than apt to disagree? But the proudest of the recent revelations is that a dentist can determine accurately by clinical instruments the nature and the amount of sideshift of the mandible. Bennett, for whom the sideshift movement has been named, showed scientifically that the motion occurs, but his method could not be adapted to clinical procedure. Recent research and invention have made this mountain a mole hill.

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1. Research Report. *D. Items Int.*, June 1939 to February 1940.

THE CONSTANCY OF THE MANDIBULAR JOINT

That the joint movements do not change during the life history is important to oral diagnosis, because we have to work to them. From all that we know, the character of the condylar movements remains constant from day to day, from age to age, as long as the individual lives, unless he has a destructive joint disease, like arthritis, or experiences some injuries from the hazards of warfare or modern transportation. They are the same all through the changes that continue in the dentition. They are the same in a mixed dentition as they are in the deciduous, the same in the permanent as in the mixed dentition; and they do not alter after the teeth are gone. They will not change from any natural or artificial misfit of the teeth, unless the resistance of the misfitting teeth is sufficient to cause temporary or permanent disease of the joints. Knowing the mandibular movements remain constant in the individual makes it possible for us to assemble the knowledge of these dynamic factors of the oral organ with a confidence that we have hitherto lacked in obtaining data for a diagnosis.

INADAPTABILITY OF THE JOINTS

The mandibular joints are very adjustable, like the wrists, for instance, but are inadaptable. They will adjust themselves to inconvenience from the teeth, but will not change to make the adjustment permanently an adaptation to changes in the dentition. Let me cite some of the evidence that we cannot make them change their basic movements or their forms by anything we do to the teeth or by muscular training exercises. We see adults who, for a long time, have been compelled to close the jaws protrusively, yet, when the tooth interference is removed, will close them centrically, just as if they had never been disciplined by a perversion. In other adults, whom the cusps of the molars and bicuspids have compelled to protrusive closure, the guidance of the joints has, in spite of the battery of interfering cusps, made the action of muscles of mastication destroy most of the cusps. We see patients whose molars, through rotation, have not complied with the movements enforced by the condylar demands, the muscles of mastication, throughout their interference, having pounded off portions of their cusps and loosened them badly or to a complete unmooring.

THE PHYSIOLOGY BACK OF THE INADAPTABILITY

Let me explain why physiologically this adaptation does not take place in the joints. The condyles can come forward to accommodate protrusive interdigitation, but when the individual bites in the lateral position, he first throws the rotating condyle into neutral, that is, the most retruded position of the condyle in the fossa, and then he begins the side movement. Hence, were there a tendency for the bone to adjust itself to the forward closure, the adjustment would be blocked when the patient begins to move the jaw into lateral position. The same is true as far as the sideshift guidance is concerned. In starting the chewing stroke, the individual does not glide the teeth together, but throws the open mandible into the right or left position by, and according to, the directions of the joints. No teeth guide it into right or left position.

Then, when he chews, the condyles retrace the paths and, when they meet, the teeth either agree or disagree with the dictates of the joints. Now, as the lateral chewing swing is made without tooth interference—that is, with the teeth apart, it figuratively "plows" the condyle path—how can the return swing, which may have tooth interference, direct the lateral glide? When the condyles move forward and downward, preparatory to a chewing stroke, they do

not have any tooth guidance, and the worn tooth, the loose tooth, the lost tooth shows that they do not accept it on the return. For years, we have had the evidence in recognized occlusal trauma that the teeth cannot guide the mandible. In all of these open movements, the condyle paths take place without tooth guidance or interference. This being true, how can tooth interference influence the condyles to change? And how can we believe that they do change with all the evidence before us that they do not? Before the adult teeth erupt, the paths are formed. We have found the same kind of variation in the temporomandibular joints in children that we find in adults and the aged, indicating that the joints do not change from childhood to old age; just as Hellman so graphically demonstrated that the angle of the mandible does not change from youth to old age, as was once universally taught and is, in so many instances, still accepted.

THE FULCRUM OF THE MANDIBLE

It might be interesting to study the action of the joints as fulcrums of the mandible. The mandible is generally accepted as a lever of the third class. A lever operates with a fulcrum to direct the amount and determine the direction of the force. A lever must have a support as well as a power attachment. Every source of power must have a base from which to operate. Archimedes said that he could move the earth, if he could only find a place to anchor his lever. Every muscle must have a support for its action. Even the intrinsic muscles of the tongue which have no bone attachment must have a base as supplied by the contraction of the muscles of the floor of the mouth to form a rigid foundation.

The temporomandibular joints are the fulcrums of the mandibular lever. They are movable fulcrums and are activated directly by the external pterygoids and the retruding fibers of the temporal and the masseter muscles. These fulcrums have long been called hinge-gliding joints. A closer examination of the movements of these joints will show that they have some of the elements of a ball-and-socket joint, because they admit of a certain amount of rotation. Many anatomists describe only the forward and backward gliding of the joint, but it does actually glide sidewise in most individuals—not very much, but a measurable amount; the Bennett movement.

INTERDEPENDENCE OF THE MANDIBULAR JOINTS

The temporomandibular joints are interdependent. The mandible is the only bone in the body that has two joints which must work together. A motion in one joint compels a compensating movement in the other joint. We call this relationship interdependence. This interdependence makes the movements very complex, because of the innumerable combinations that can take place. They appear complicated to those who do not understand them. In the simple opening movement of the mandible, the joints act on a common axis. This action takes place anatomically by the rotation of the head of the condyle in the lower surface of the meniscus. It is possible for the mandible to have this simple opening component to the extent of separating the incisors as much as an inch and a half. In any case, it would be safe to say that the individual can separate his incisors a half-inch without any compelling forward movement of the condyles. One of the confusing facts about this opening component of action is that it can be accompanied by a contraction of the external pterygoids which pulls the condyles and the menisci forward in the temporomandibular fossae. This combined action is a natural element of the chewing motions and especially the prehensile or biting impulse. Therefore, when the individual is told

to open his mouth, he will automatically combine these movements. In order to determine the true opening component of action, it is necessary to see to it that the individual does not combine these movements. This is sometimes as difficult as it is for the oculist to disregard the accommodating factors of eyesight in determining the true anatomic refraction of the eye. He has one advantage over us—he can paralyze the accommodation factors and get rid of the bothersome component of accommodation. The only way I know of to offset this protrusive tendency would be to clout the patient on the chin, but I doubt whether this would be good dental practice, as much as we would like to do it sometimes.

In protrusion, the condyles may go forward the same distance, or one may make a longer glide than the other, a protrusive lateral glide resulting in which the one pursuing the shorter course is subjected to a compensatory amount of rotation. Or, in what might be called a pure lateral action of the mandible, the condyle of one joint would travel forward, downward and inward, while the other condyle would be subjected to a simple compensating rotation. In cases of this kind, there is no Bennett movement or sideshift. In many individuals, the pure lateral movement is accompanied by a forward and an inward movement of one condyle, in which the inward movement is greater than the simple rotation of the opposite condyle would allow. There is, then, a compensating sideshift of the opposite condyle to accommodate the natural inward movement of the forward-moving condyle, which is known as the Bennett movement. With the interdependent movements of the condyle, we get the opening-closing axis, the protrusive, the protrusive lateral, the basic lateral, with or without the sideshift, as the joints dictate. No wonder, with all these possible combinations of movements, that the joints seem complicated! More wonderful still, they can have a mechanical counterpart: man can make an instrument that will reproduce these movements in all their complexity. When studied from this standpoint, they are not so complicated after all. We have for a long time heard much about anatomic articulators. Unless they actually reproduce the movement of the mandible, they are not "anatomic." The time has come to talk about physiologic instruments.

Variations in the Bennett Movement

A brief summary of the variations of the Bennett movement is as follows: The Bennett path may be in a straight line, directly sidewise; but it generally is not. It may not be even a straight line. It is generally a curved line. It may go outward and forward; it may go outward and backward; it may go outward and upward, or it may go outward and downward. In any case, the individual will have a Bennett path that is purely personal to him. And the two sides of the individual may also be, and generally are, different. I have already stated the anatomic reason for the occurrence of the Bennett movement, which is due to the directing form of the joints and is not the result of the so-called muscle balance.

The Influence of the Bennett Path

The influence of the Bennett path upon the motions of the jaw is greatest in the region of the molars. The molars have to be adapted to it in the arrangement of their cusps and ridges, because the mandible makes arcual lines as directed by the Bennett path. In the analysis of traumatic factors, in tooth or cusp interference, the knowledge of the patient's Bennett path becomes of paramount diagnostic importance. In full denture prosthesis or mouth reintegration, any articulating instruments intended to imitate jaw motions that do

not definitely reproduce the Bennett paths cannot have dental prostheses fabricated upon them that will articulate. If an attempt is made to restore a part, or all of the natural teeth, how can this compelling fact regarding the Bennett path be disregarded?

THE VARIATIONS OF THE CONDYLE PATHS

The variations of the condyle path are just as important as the Bennett paths. The condyle paths vary in two ways: in inclination and in curvature. By inclination of the condyle path, we mean the degrees between its main direction and a plane designated as passing through the axis points and a point at the floor of the right orbit, known as the axis-orbital plane. For a long time, men have talked about condylar inclination without reference to any established plane. If Wadsworth contributed nothing else, he showed the fallacy of such indefinite angular reference. A condyle path that in its course most closely approaches this plane is commonly called flat. A condyle path that diverges obliquely to this plane is called steep. We find all degrees of inclination between these two extremes. We could virtually never find the inclination of the paths to be the same in two patients; rarely the same in the two sides of a patient. The curvatures in condyle paths vary widely, from almost straight lines to sharp small curves, and even the curves are rarely inverted. The curvature of the right condyle path may differ from that of the left condyle path.

RELATION BETWEEN CONDYLE VARIATION AND ARTICULATION

The details of articulation are many and involved. They have been quite comprehensively set forth by Charles E. Stuart and me in *Dental Items of Interest,* June 1939 to February 1940. The relation between the variations of condylar path slants and curvature and the arrangements of the teeth was fully and clearly set forth in a paper by Harvey Stallard in THE JOURNAL, March 1937. Stallard showed that given forms of teeth could be articulated to given condylar variations by simply changing the curve of Spee or the occlusal plane, or both. This knowledge is important to diagnosis, as well as in treatment, because it gives the clue to how independently formed teeth are able to arrange themselves to suit the demands of the condylar movements, and is of course the basis of orthodontic treatment.

THE PHYSIOLOGIC COORDINATION OF THE INDEPENDENTLY FORMED FACTORS OF THE ORAL ORGAN

The parts of the oral organ are figuratively made in separate factories. They seem to be made independently in form and size for specific purposes. This idea is borne out by the fact that tooth germs, in a microscopic state, have been taken from the jaw and placed *in vitro* and have developed completely and independently of the original environment. This is also true of bone. The femur and other bones of the chicken have been developed in an artificial medium, entirely independently of any other structures, to complete bones with processes for muscle attachments, complete joints and a corresponding internal architectural structure of the bone, just as if it had grown in the animal. Are we not right in saying that this would be true of the mandible or the maxillae? This is surely an indication that the parts are developed independently, uninfluenced by other contiguous structures. May we not say that these independently formed parts are assembled into the oral organ by the growth of the organism? That leaves the way open to two basic explanations for anomalies: (1) a lack of proper formation of the parts and (2) a lack of proper assemblage. These two conditions may even be mixed; that is, the parts may be properly formed and improperly assembled; this giving a third

explanation of an anomaly. A fourth explanation would be extraneous conditions interfering with development and growth, such as disease and posture. Function does not produce these combinations. The correct parts plus correct assemblage results in correct function. A wrong combination results in malfunction or no function at all. Function is a result and not a creator of an organ or organism. The motor makers have long learned that the function of the engine will not complete the coordination, if the parts are not accurately enough made and properly assembled. The forced functioning of an engine not well made or well assembled, or if well made but improperly assembled, will lead to its destruction.

THE CONCEPT OF THE NORMAL

Probably, foremost in the mind of every dentist is a grasping for a concept of the normal, or a rule by which we can measure the extent and kind of treatment to be administered. This urge has resulted in men laying down a set of rules based upon geometric designs or arbitrary mechanical measurements, such as the equilateral triangle or the 4-inch radius plus the spherical theory of jaw motions. Human beings are not cast in molds. The variations in the parts of any organisms are subject to innumerable combinations. We can have long faces, flat faces, wide faces, narrow faces, etc. When we study any particular organism, we measure it not with a tape line or a geometric design, but by a study of the reciprocal action of the parts presented. In other words, what we do is to test its function. For instance, we do not have to go very far in our thinking to know that high cusps with a high occlusal plane will not harmonize with a flat condyle path. Malformed or misplaced cusps cannot coordinate with their opponents. Tipped rotated teeth, no matter how well formed, cannot cooperate. The assemblage might be beautiful according to our concept of beauty, and yet not be coordinated. By the same token, it might be ugly, and yet perform its work well. I once stated, during a heated discussion, that the word normal could be disposed of in a very simple way by stating that the normal mouth, as far as the individual dentist is concerned, is what he thinks it should be. The concept of the normal is dependent on the intelligence and the education of the man behind the concept. The uneducated though intelligent dentist would think that a mouth free from caries was necessarily normal, if it looked well to him. The knowledge of the destructiveness of the disagreement and conflict of the parts of the mouth would not enter the realm of his concept, except through education. For many years, dentists have had this condition before their eyes. Too many have looked, but have failed to see. There is no rule for a concept of the normal. The whole problem resolves itself into knowing oral physiology. No definition will ever produce a concept of the normal. The question, "What is normal?" does not admit of an answer. It requires an education. The problem must be lived with and developed. Without this extremely fundamental concept, both dentists and physicians are prepared to treat only symptoms. Their patients are only "comfortized." Patients are enabled to lose their teeth comfortably or die before their time without suffering too much. Only a keen concept of the normal enables the doctor to detect and intercept the processes and progress of disease in its incipiency. The whole field of preventive health service is dependent on the development of an adequate concept of the normal. Both dentists and physicians must learn to detect the fire before the roof caves in.

THE WONDERS OF MOUTH DEVELOPMENT

Let us consider for a moment the wonders of mouth development. The

teeth are commenced very early in fetal life. They are made in a factory deep down in the bones of the jaw. When the child is born, it has fifty-two potential teeth. They are all formed in this "subterranean" factory to the complete size and form of their crowns. The enamel organ does all of its work independently of any possible outside influences. It does it as though it had a blueprint of its own which it followed without consulting anybody. Early in fetal life, plans are laid for the temporomandibular joints. And they too grow according to blueprints of their own. As the teeth are developing independently, the joints are growing independently. There are no visible or mechanical connections between the two. The deciduous teeth come upon the oral stage singly and take their place with rhythmic stride, as if pushed into place by the very pulse of life. To the great architect of growth, or whoever holds the master blueprint, is left the problem of assembling these parts into a coordinated entity. To this great architect is also left the problem of developing the muscles, bones and nerves to operate this organ. The unmuscled teeth stalk into the chorus of action by forces outside themselves. They are helpless. They go willy-nilly into their allotted spaces to become the instruments of the main actors, the joints and muscles. The deciduous teeth are later joined by the first permanent molars, then they begin departing one by one, to be replaced by the adult teeth. Near the end of this replacement, additional marionettes, the second adult molars, take their places at the ends of the troops. The teeth are as helpless to direct their arrangements as they are to repair themselves. Growth forces and growth directions carry them upon the oral stage to play in a symphony of action or to stumble awkwardly in a poor tragic scene of disorder. Yet when the chief architect performs his function adequately, the lower teeth are elevated out of the darkness of their crypts to meet with their opponents that are lowered out of the maxillae. They come together, enmesh and match ridges without disturbing the relation of the jaws, and they will have proper inclination and be properly rotated upon their axes so that they can maintain contact relations in any or all of the chewing movements of the jaws. Oral diagnosis is concerned with this entity throughout its formative period as well as during its adult form and during the period of natural deterioration that comes with old age.

CONCLUSION

Can dentistry have a system of oral diagnosis without an adequate knowledge of the factors involved in the building and maintenance of the oral organ? It seems that a knowledge of the rôle of these factors in the shaping and functioning of the oral organ is of paramount importance to oral diagnosis. The periodontist has done many things to find out what causes deterioration of the parodontium. He has even assumed that malarticulation plays a prominent part in parodontal destruction. He has recognized the term "occlusal trauma," but he has never made a systematic study or developed a method of differentiation whereby he could determine the relation of trauma and infection in parodontitis or paradentosis.

How can the full-denture prosthodontist ever be certain of the causes of the decline of the alveolar ridges without a knowledge and careful consideration of the demands of jaw motions? How can the orthodontist, in his diagnostic procedure, disregard the most careful consideration of the condylar controls and the corresponding dictated relations of the teeth? How can the pedodontist predict and make his prognosis of the future condition of the oral organ without the knowledge so sketchily suggested here? How can the general practitioner who is called upon to maintain, repair and, in

many instances, redintegrate a mutilated oral organ disregard these fundamental principles? Oral diagnosis and the knowledge underlying it are not for any particular specialty of dentistry. The procedures parallel and are in principle applicable to all branches of the healing art, because these principles are born of physiologic and anatomic knowledge.

Fear of more and newer knowledge is a common attribute of every profession. This fear often becomes an excuse for non-acceptance. Often, this fear is founded, in the uninitiated, upon the results obtained by those who prostitute the principles by attempts to "make it easy." There is no royal road to diagnosis in dentistry. Dentistry is difficult—the more we know about it, the more difficult it becomes. It takes more than the ordinary man or mind to master its difficulties. These difficulties are what set dentistry apart, and the mastery of them could give dentistry its place among the learned professions.

This discussion is not presented with any undue desire to impress the reader with one's profound knowledge of the inexhaustible problems of oral anatomy and physiology, but in the hope that it may awaken a keen appreciation of the need for a basic understanding of the function of the organ that dentistry has obligated itself to treat. Recently, I listened to a lecture on the treatment of the kidneys. The greater portion of the lecture was on renal physiology because, as the lecturer said, a knowledge of the physiology of the kidneys must form the basis of all proposed treatment. So it is with all the specialties of medicine. Can the mouth be an exception?

Professional Building.

PRESENT RESEARCH STATUS OF DIRECT ACRYLIC RESTORATIONS

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BEFORE acrylic resin (methyl methacrylate) was used routinely for crowns, bridges and inlays, intensive experimental work was conducted on this plastic for direct fillings. At that time, restorative acrylic resin was unavailable and high polymer denture resin was utilized. No definite technic was followed. The polymer element was simply allowed to become sticky in the monomer, and it was introduced into the cavity much the same as sticky cement. No great pressure was applied, and warm instruments were used to form the labial surface.

In May 1939, C. R., a girl, aged 17, was selected as a suitable subject for experimental acrylic fillings. This was one case in which caries could not be controlled. All the teeth were carious. Hypertension, nervousness, apprehension and non-cooperation all contributed toward making conditions worse. Family, physician, fiance and patient desired total extraction and dentures, for appearance's sake and for freedom from worry. The teeth were all vital. Consultation resulted in patient and family agreeing to a trial period during which we would try to arrest the caries and

overcome the patient's fears. During the month, fillings were placed under local and general anesthesia. Among these were six acrylic fillings. It was believed that chances were poor for saving the teeth and that this step was warranted. Many of the carious areas were too irregular for inlays, too deep to allow complete amalgam fillings and too extensive to admit cement bases with remaining undercuts sufficient for strength and retention. The silicate cements were not considered owing to the high rate of caries progress. Patient and family were told of the type of fillings being placed and agreed to continuance of the work.

SIGNIFICANT RESULTS

The results of the direct acrylic restorations were not good. A few fillings became loose during hardening, although they did not come out because of deep undercuts. A few of the loose fillings were replaced, with incomplete or partial success, due in great part to the technic utilized. However, it is significant that two of these fillings were apparently successful from a hardening and a service standpoint. It is also highly significant that although all of these fillings were placed in vital teeth, in no instance did a sensitiveness result that would indicate an irritation of the pulp. This significance is further augmented by the fact that teeth were filled which were progressing toward or already in a state of hypersensitiveness. In no cases were cement bases used. The prognosis of the acrylic restorations which were successful seemed good. However, in six months, it was necessary to make complete extractions, owing to non-cooperation of the patient, and on the advice of the physician. Many teeth were extracted which, in a healthier mouth, would have been considered good risks. Among these were the teeth filled with acrylic resin. Complete dentures were very evidently indicated from the patient's mental standpoint, and all other considerations were waived. The apices of the extracted teeth filled with acrylic appeared normal, although no point is made of this fact. Experimentation and research then continued from the standpoint of the processed methyl methacrylate, as the esthetic effects of the direct restorations were not satisfactory. All considerations of direct fillings were left to a later date.

CONTINUATION OF EXPERIMENTAL DIRECT FILLINGS

After the restorative acrylics were in routine use in various practices, and during the months of March, April and May of the year 1941, more direct restorations were made. By this time, fine grain polymer, which was necessary from an esthetic standpoint, was available. Fillings were placed with the technic used for blending jackets and bridges. This was the slab technic, in which the dry polymer was placed on the slab and the monomer introduced drop by drop until there was saturation. This sandy mass, when it became manipulable with cement instruments, was introduced into the cavity, and cellophane was placed over the mass. Finger pressure was utilized for from ten to fifteen minutes, or until the mass became doughy and did not pull away from the cavity margins. It was necessary to wet the cellophane before releasing it. A few interproximal Class III cavities were filled, celluloid strips being utilized. The strips had a tendency to split when contact was made with the acrylic filling. Cellophane, folded in three or four layers, was then utilized for this work, being held firmly for from ten to fifteen minutes. The fillings were trimmed during the original setting, after a sufficient time had elapsed for a surface hardness to develop over the acrylic. During the placement of gingival fillings, the finger

pressure very often gave a concave rather than a convex surface. This was overcome by overfilling the cavity first with wax. Next, a small wet piece of cellophane was laid over the wax and softened compound pressed over the cellophane, with a few adjoining teeth as an index. The compound was chilled. The wax was then removed from the cavity. The acrylic was placed with silicate instruments. Wet cellophane was placed over the acrylic. There was then pressure from the compound rather than direct thumb pressure. In the foregoing cases, only cervical, gingival Class V and interproximal Class III fillings were utilized.

RESULTS

At a subsequent examination, at least 50 per cent of these fillings had become loose. Not one was observed to fall out, because of sufficient undercuts. The loosened fillings were a source of annoyance to the patient and a slight sensitiveness developed. However, the fillings that remained in place were apparently sound. It is again significant that in these acrylic fillings that remained solid, no irritation of the pulp occurred. The fillings that became loose were replaced by orthodox methods as the patients had been previously told what was going on and it was not desired to utilize them further for experimentation. Owing to the war, it has been impossible to check on all of the restorations of which the prognosis seemed favorable. On those few observed in April 1943, two years later, the fillings are still in use and are serviceable, and, except for purely esthetic considerations, would be termed ideal.

WORK OF CONTEMPORARIES

During the time between April and May 1941 and May 1943, letters have been received from others who are placing successful direct acrylic fillings. G. B. Salisbury's articles in the *Dental Digest* duplicate these results. Although some of the theories presented by Dr. Salisbury are open to question, his work on the whole has been substantiated. More than 200 successful restorations have been either made or observed by Dr. Salisbury. The slight variation between his technic and the one presented here is due in part to improvements made since his original articles appeared. No attempt is hereby made to establish originality by inference, dates or the technic presented in this paper. Dates are presented to establish authenticity only. Technic is presented only as a correlation between research and practice.

EMPHASIS

Direct acrylic fillings can be successfully placed only by following the few principles laid down. Any effort at shortcuts will result in failure. One prime requirement in this work is greater skill than is demanded in fine synthetic porcelain work, the delicacy of touch of the amalgam worker and the cooperation of the patient during hardening time. It is this hardening time which spells the doom of many otherwise good acrylic fillings. Restorative acrylic materials now on the market for jacket crown, bridge and inlay work will not suffice for this work. Various experiments have indicated the possibility of developing special polymers and monomers the polymerization time of which will be materially hastened. A few are even at present available.

COLORS

During slow polymerization, colors and shades are entirely different from those of the same powder and liquid polymerized under pressure and heat, as in crown, bridge and inlay work. At the present time, polymers and monomers are available, the polymerization of which has been accelerated to a degree where the filling is hardened in twenty-

four hours. In extensive restorations, complete hardening has taken place overnight with polishing the next day. Shades are being developed that will conform closely to those of the synthetic porcelains now in routine use.

PULP CONSIDERATIONS

Consideration of the pulp is vital. It comes before rapid polymerization, and the physical and esthetic considerations of the fillings. It is emphasized that monomers of doubtful purity are contraindicated. Pure monomer is essential. It is primarily an inert salt. Organically, it is known as an ester. Distilled or multidistilled monomer from scrap polymer is not to be considered, nor is commercial monomer. All of these may contain traces of methacrylic, acrylic or formic acid, as well as other impurities. In our present experiments, not only is the pure monomer used, but it is further neutralized to make it entirely safe.

POLYMER SIZE

Naturally, fine grain polymer must be used for esthetic reasons. Too fine a grain polymer is not indicated, since ultra-fine polymer will be completely dissolved in the monomer, an excess liquefaction resulting which defeats our purpose, the application of sufficient pressure prior to the dough and hardened state. This grain size has been adequately ascertained and is available.

MOISTURE PROOFING

An inert varnish has been developed for application to acrylic surfaces and is used to cover the restoration area before dismissal of the patient. It is applied with a small brush over the entire acrylic surface and allowed to dry thoroughly. Drying occurs in a very few minutes. This moisture-proof seal allows the acrylic to harden under dry conditions, and, it is believed the shade is retained better. Ordinary varnish will not suffice for this work as it is dissolved or absorbed during polymerization and not only is its moisture-proof effect lost, but actually the filling itself is affected. This inert varnish is prepared especially for plastic surfaces.

CEMENTATION

Cementation of acrylic inlays can be accomplished in the same manner, although a thinner mix is necessary. Before the inlay is to be inserted, undercuts should be made in the prepared cavity. These undercuts and the walls of the cavity are then filled with the thin, but definitely tacky (not sandy) monomer-polymer mixture. No attempt should be made to apply the material to the inlay itself. The inlay is then placed in position and tapped into place by means of an orangewood stick and a horn mallet. The excess sticky material oozing from the margins should be carefully wiped away, with care to wipe toward the tooth and not over the inlay itself. An immediate coating of acrylic varnish is then applied over inlay and margin, and the finishing is accomplished twenty-four hours or more later.

FURTHER POSSIBILITIES

Very deep or very extensive cavities can be built up in two operations if necessary. The first acrylic layer may be placed in position and thorough hardening accomplished over a period of two or three days. On the next visit, the hardened first layer can be roughened with a bur and the remainder be placed against it, and built up for contour and occlusion. The second layer will become part of the first layer molecularly, and if the work is properly done, should be as strong as though the filling were placed in one piece. No monomer should be applied before placement of the second layer. If the proper consistency of monomer-polymer has been obtained, adher-

ence and combination will be complete.

STERILIZATION

Semipermanent or permanent sterilizing materials may, it seems evident, be incorporated in the polymer or monomer. At the present time, bactericidal tests are being conducted on this subject.

TYPE OF CAVITIES

It is especially emphasized that the following cavities only should be attempted: gingival and cervical Class V cavities, approximal Class III cavities and occlusal Class I cavities. All technics at the present time should be classed as experimental and carried out only with the permission of the patient, and after considerable work on models.

MONOMER-POLYMER MIXING

The literature contains certain references to a sandy mass. This is not exactly in accord with our experiments. It is believed that no free monomer should exist in the monomer-polymer combination at the time of placement in the cavity. After the polymer has been completely saturated with the monomer, spatulation or stirring or another form of manipulation should continue. Three stages will be noted: The first stage is one of sandiness, at which time the material feels crunchy and is not smooth. The second stage is one of tackiness, or stickiness, and smoothness. When the spatula is withdrawn from the mass, little cobweb-like strings form. The third stage is one of smooth stiffness. At this time, no cobweblike strings are formed and the mass tends to stick to itself rather than to the spatula or the slab or jar. The beginning of the second stage is that which we wish to use in direct work. All free monomer by this time has been either absorbed by the polymer or has become of a thick syrupy nature. It will instantly be apparent that although the material at this time can be pressed into all undercuts and deep parts of the prepared cavity, the thickness of the monomer prevents its being forced into the dentinal tubules. If free monomer were present, as in the sandy stage, this might be forced into these dentinal tubules, with consequent irritation. Although the sandy mix has been used with apparent success and with no apparent irritation, this conservative measure is especially recommended.

ALLERGY TO METHYL METHACRYLATE

It is emphasized that this work is still in the experimental stage. This paper is presented as a report on the present status and not as the result of completed work. Although the outlook is encouraging, it is recommended that all work be done from an experimental standpoint and first be attempted on extracted teeth. It has been shown that some people are allergic to methyl methacrylate.

TECHNIC

The following technic is advanced as a starting point for this work:

1. Place sufficient powder in a small jar.
2. Introduce enough liquid to just saturate the powder. If the powder becomes too wet, add more powder until the excess liquid is absorbed.
3. Lightly spatulate this until it approaches the smooth, sticky stage. The wet sand stage should just be passing, and the material should feel smooth. This will take from approximately thirty seconds to two minutes, the time depending on the temperature.
4. With silicate instruments, pack in the cavity the same as for silicate, taking care not to touch the gum or other tissues. The use of rubber dam is indicated.
5. Fill the cavity to excess and then cover with wetted, but not wet cellophane.

6. Apply pressure with the previously prepared compound index for five minutes.

7. Withdraw compound and moisten cellophane.

8. Carefully remove cellophane without pulling the margins.

9. Paint with resin varnish.

10. Have the patient wait for from one-half to one hour, at which time the excess acrylic can be removed. Do not touch the margins or surface of filling.

11. Paint with acrylic varnish.

12. Have the patient return after twenty-four hours (forty-eight hours for large fillings), at which time the margins and surfaces can be polished.

13. It is emphasized that, in no instance, should the polymer-monomer combination come in contact with the mucosa of the patient or fingers of the operator.

Caution: Do not burnish filling or margins with a hot instrument at any time. Do not add monomer to the open cavity or filling. Protect adjoining membranes and acrylic work with vaselin, or preferably a rubber dam.

Do not use any but materials especially prepared for this use. Prepare all cavities with sound undercuts and box preparations. Do not bevel the margins. For the present, it is advised that a cement base be used wherever there is close proximity to the pulp.

All precautions applicable to sound filling work should be taken, including removal of all decay, and sterilization and the toilet of the cavity.

THEORY

The present theory on this subject is somewhat obscure. There is slightly more than 20 per cent contraction in monomer polymerization. Polymer is already polymerized, though not completely compressed. Monomer-polymer shrinkage during polymerization is around 7 per cent, depending on particle size. Shrinkage is less as polymer size decreases, up to a certain point. With direct fillings, we do not achieve perfect density such as is obtained in making a clear section with heat and pressure. Probably, a monomer-polymer cementation occurs. The point to consider is that the cementing liquid and powder are chemically the same, thus forming a solidly homogeneous, if not completely dense mass. The fact that it adheres to and does not pull away from the margins of the tooth cavity is probably due to the proximity and geometric arrangement of the polymer. Under sliding pressure, they will be bound on all sides by one another. The surrounding monomer dissolves only the surface of the polymer, owing in part to temperatures of less than 100° F. Polymerization of the liquid which has been artificially accelerated takes place before the complete softening of the polymer. Thus, the polymer itself forms a structure barrier against shrinkage forces exerted by the monomer. As the polymerizing monomer cannot draw the pearls closer together, since they are already in proximal relationship, the monomer itself alone shrinks, a structure full of minute voids resulting. This may be no handicap from an absorption standpoint, as the structure probably resembles foam glass, that is, glass full of bubbles, very light and perfectly impervious to moisture. It is, in effect, a cellular structure weaker than the dense clear methacrylate, but still conceivably possessing strength in excess of that required for certain fillings.

Thirty-Second and Spring Garden Streets.

THE PROMOTION OF RESEARCH

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A PROFESSION exists as such and advances as a result of the research and investigative activities of its members. Failure to promote this type of activity dams up the stream of progress, so that the profession follows an empirical type of practice based on the accumulated habits of past generations. In the training of dentists, research is recognized as the vitalizing force in the educational process through which the practitioner of tomorrow is led to continue his education after graduation. It is research in the dental schools that fertilizes the textbook statements read by the students and transforms them from the expression of some other man's opinion into a part of the working knowledge of the individual. Until a man has first-hand experience in a field, based on having actually attempted to create knowledge in that field, he cannot teach with authority, nor with absolute conviction. The best professional education, as contrasted to trade school training, is given in those schools that have the most vigorous research programs. Therefore, it is pertinent to inquire whether the policies of dental organizations are promoting this research activity, and thereby helping to improve the level of dental education and practice.

The American College of Dentists has taken a broad view of the rôle of research by establishing fellowships and grants for the prosecution of scientific problems. Unfortunately, the American Dental Association, which should be the leader in this field, has failed to measure up to its full responsibility to view this problem from a long range standpoint. The Association has chosen to expend a fairly considerable amount of money for biologic research under the auspices of the federal government. This puts the Association in the somewhat ludicrous position of trying with a small subsidy to entice the American government to carry on a program of public value.

Other scientific societies, such as the American Association for the Advancement of Science, the American Medical Association, the American Geological Society, the American Philosophical Society, Sigma Xi, and many others have dealt with this problem for many years, and have arrived at procedures for promoting research which are much more effective than the present program of the American Dental Association. For instance, the American Medical Association makes small grants each year to many individuals to be used to help defray a designated part of the actual expenditures for materials and supplies in a specific program. This ordinarily does not include any money to be used for salaries. Thus, in 1941, the American Medical Association's Committee on Scientific Research awarded $7,550 to 25 groups of investigators, or an average sum of $315 per group. In the same year there were published from such grants, 66 papers in reputable medical journals. In addition, the Committee on Therapeutic Research of the Council on Pharmacy and Chemistry of the American Medical Association, a body which is similar to the Council on Dental Therapeutics, granted $6,500 in the same year to 30 groups of investigators, or an average of about $215 per problem. Under these auspices 59 research papers were published in that year.

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Presented before the Research Seminar June 15, 1943.

In other words, by the expenditure of two sums of money, each similar to that which the American Dental Association now spends for a single biological research program under the U. S. Public Health Service, the American Medical Association created 55 separate research programs, from which there resulted more than 100 scientific papers. Instead of paying all the research costs of a single investigator, they chose to stimulate a large number of groups to active work with small grants, and thereby to create throughout the country many foci of research interest and endeavor.

The grants of the various scientific societies mentioned are made in this way annually, shifting them around to various individuals and institutions in accord with requests for assistance and the need and value of the projects. Over a period of only a few years, literally hundreds of research projects are initiated and fostered with a total expenditure no greater than ordinarily would be incurred from a single project under the present policy of the American Dental Association.

If there is a pressing problem, which requires immediate solution for the preservation of public health or safety, it sometimes may be in order to buy an answer to that problem quickly by putting an adequate sum of money in the hands of an established investigator, so he can make this his prime responsibility until the problem is solved. A procedure such as this is obviously desirable for control work, and in the establishment and continuous maintenance of standards for materials, such as has been so effective in the Bureau of Standards under the Research Commission for many years. But its success as a means of creating standard specifications for dental materials does not mean that the same procedure will be equally effective in promoting the other objectives of research.

The American Dental Association would do well to regard their responsibilities toward research from the broadest possible standpoint. It must not be overlooked that the dignity of dentistry as a profession, and the maintenance of its position as an independent discipline, depends on contributions by the whole profession to the broad field of medical knowledge. Over the span of years, the greatest volume of contributions is to be secured only if, in every dental school and institution, research is actively and vigorously pursued as a part of the institutional policy and as an accepted duty of each individual. To throw responsibility for research into the lap of the federal government is to stifle the incentive for investigation in the teaching institutions, and to rob it of influence on the minds of the teachers and their students. It also implies a criticism of the ability of dental institutions to carry on effective research programs. To hand practically all available research money over to the government may be an easy way to avoid responsibility, but it cannot be defended as a sound procedure.

The Association has already taken a step in the right direction by permitting the Council on Dental Therapeutics to make certain small grants for assistance in research in fields in which the Council needs special advice. It would seem desirable to greatly expand these grants. The Association should also reconsider the other aspects of its program for the promotion of research, to see whether it cannot utilize the accumulated experience of the other organizations in this regard, by stimulating numerous research programs throughout the entire country.

The great modern scientific development of the learned professions has arisen because the members of the profession are steeped in the research attitude at the time they receive their technical education. The American Dental Association can help to promote that same attitude in the dental schools by recognizing its obligations and opportunities in this direction, and by taking a long range viewpoint of the methods likely to achieve the greatest results.

INTRASTATE GEOGRAPHIC VARIATIONS IN DENTAL CARIES RATES

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INTRODUCTION

GEOGRAPHIC variations in dental caries rates have been reported, either directly or indirectly, from time to time in the dental literature. In the majority of these reports, however, the geographic observations have been incidental to the major findings to which the studies were devoted, and thus have received but little attention.

The recent findings of Dean[1] and his associates with regard to the apparent relationship between dental caries rates and minute quantities of fluorine in drinking water have stimulated much interest in the subject of regional variations in dental caries that might be associated with certain environmental factors. In view of the established fact that geographic variations in incidence are characteristic of many of the bacterial diseases of man, it appears logical that dental caries, which has been shown repeatedly to be associated closely with the presence of lactobacilli, should exhibit similar geographic characteristics.

During a period of four years, in my former capacity as senior dental officer of the Tennessee Department of Public Health, I had observed, in the examination of school-age children throughout the state and in the review of reports submitted by my associates, an apparent fluctuation in dental caries rates among the children of different sections of the state. Accordingly, I believed that a detailed analysis of these findings in the three main geographic divisions of Tennessee should furnish reliable information concerning comparative rates for dental caries among children of these areas. Furthermore, it was thought that observations within the boundaries of a single state should constitute reasonably conclusive yet conservative indications of geographic characteristics for larger areas.

Numerous theories have been advanced in the past to explain the causative factors involved in these regional differences. Thus, before analysis and interpretation of the results of the Tennessee study, the literature on this subject was reviewed carefully to obtain the consensus of scientific opinion as to the major environmental influences apparently associated with geographic variations in dental caries rates. The general conclusions derived from this review are briefly summarized as follows:

1. Variations in the incidence of dental caries can be found in different geographic sections of the United States and other countries.

2. There is an apparent inverse relationship between dental caries rates and the amount of sunlight in different regions.

3. Certain constituents of drinking water, especially fluorides and possibly the carbonates (determining the hardness), seem to have an inverse relationship to the caries rates of the population using the water.

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Abstract of a thesis submitted in partial fulfilment of the requirements for the degree of master of science in public health, University of Michigan, 1941.

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4. A relationship between economic conditions and dental caries rates has been suggested, but not clearly established.

5. The racial composition of a given population group may have a marked effect upon the extent of dental caries shown by the group as a whole, particularly where the population includes a relatively large percentage of negroes.

THE TENNESSEE STUDY

Collection and Tabulation of Data.—The data used in the Tennessee study represent the findings of a single examiner, Dr. Carl L. Sebelius, during the dental examination of school children in thirty-nine counties of Tennessee over a period of approximately three years. The examinations were a part of the regular dental hygiene demonstration programs that are carried on by the Tennessee Department of Public Health, in cooperation with the various county health departments of the state, for periods of from three to four weeks per county.

All of the children whose examination records are included in the study attended typical rural or semirural elementary schools. From an economic standpoint, they represent all classes in their respective communities. In the majority of counties visited by the examiner, from fifteen to twenty schools were included in the survey, and approximately 500 to 1,000 elementary school children were examined. The records of all negro children have been excluded from the data used in this study because of the uneven distribution of the negro population in Tennessee and because of the difference in dental caries rates between white and negro children.

The dental examinations reported in

TABLE 1.—SUMMARY OF DENTAL EXAMINATION FINDINGS FOR 26,576 WHITE CHILDREN, AGES 6-15, IN THIRTY-NINE COUNTIES OF EAST, MIDDLE AND WEST TENNESSEE

Age	Number of Children Examined			Total Caries Experience Rates per 100 Children			Differences in Rates by Sections (with Standard Errors)		
	East Tenn.	Middle Tenn.	West Tenn.	East Tenn.	Middle Tenn.	West Tenn.	East Minus Middle	East Minus West	Middle Minus West
6	1,089	1,123	673	454.2	432.2	411.8	22.0 ±8.9	42.4 ±10.1	20.4 ±10.0
7	1,078	1,217	600	609.8	525.1	498.4	84.7 ±10.0	111.4 ±11.8	26.7 ±11.2
8	1,551	1,697	992	634.6	532.3	527.4	102.3 ±8.5	107.2 ±9.7	4.9 ±9.2
9	1,098	1,487	674	512.4	456.3	438.2	56.1 ±8.8	74.2 ±10.6	18.1 ±9.8
10	1,323	1,668	713	418.4	372.1	328.8	46.3 ±7.4	89.6 ±8.8	43.3 ±8.3
11	623	1,011	330	385.9	298.4	305.2	87.5 ±9.6	80.7 ±12.4	—6.8 ±11.0
12	787	1,302	535	351.4	266.5	270.0	84.9 ±8.1	81.4 ±9.8	—3.5 ±8.4
13	655	1,372	509	358.6	299.4	321.9	59.2 ±8.8	36.7 ±10.9	—22.5 ±9.2
14	413	896	330	388.1	315.6	275.5	72.5 ±11.4	112.6 ±13.3	40.1 ±10.9
15	160	505	165	368.1	346.7	326.6	21.4 ±15.1	41.5 ±20.6	20.1 ±16.3

this study were made according to a standard technic. Using a good mouth mirror and sharp dental explorer (No. 23), and with the child facing a good light, the examiner observed and recorded the condition of each tooth present in the child's mouth. A carious defect was defined as any demonstrable area of decay involving one or more surfaces of a tooth. Pits and fissures were counted as carious defects only if they permitted the definite penetration of the explorer.

To secure an approximate measurement of the amount of dental care received by the child examined, the number of fillings present in the deciduous and permanent teeth was recorded for each child. Also, to provide data for calculation of the lost permanent tooth rates, the number of previously extracted permanent teeth and the number of permanent teeth indicated for extraction at the time of examination were recorded.

The sex and age at the last birthday were recorded for each child examined, and the name of the school, the county and the date were noted on each school summary sheet.

The dental hygiene summary reports by counties, from the files of the Tennessee Department of Public Health, were used to tabulate the data for the three geographic divisions of the state. These included sixteen East Tennessee counties, fifteen Middle Tennessee counties and eight West Tennessee counties, separated according to the specific designations used by the University of Tennessee for its official publications.

Tabulations were made on the basis of ages by years, and those children under 6 years and over 15 years were excluded from the study because the numbers examined were considered too small to be reliable. Averages were calculated on units of 100 children, according to the method employed by the U. S. Public Health Service on similar studies at Hagerstown, Md.

TABLE 2.—SUMMARY OF CLIMATOLOGIC DATA FOR THREE GEOGRAPHIC SECTIONS OF TENNESSEE, 1920-1939*

Section of State	Average Number Clear Days per Year	Average Number Partly Cloudy Days per Year	Average Number Cloudy Days per Year
Entire state	161.9	93.6	109.9
East Tennessee†	145.7	105.9	114.0
Middle Tennessee‡	156.5	97.1	111.8
West Tennessee#	178.9	83.0	103.4

*U. S. Weather Bureau: Climatological Data for the U. S. by Sections; Annual Summaries, 1920-1939, Tennessee Sections.
†Reported from thirty-one observation stations.
‡Reported from thirty-six observation stations.
#Reported from eighteen observation stations.

Findings.—The results of statistical analysis of the data for East, Middle and West Tennessee children are shown in Table 1. The total caries experience, including the number of carious defects, treated and untreated, and the number of permanent teeth previously extracted, is designated for each age group of children examined in each of the three geographic sections of the state. The differences by sections for each age group, with the standard errors of these differences, are also listed.

Strikingly consistent differences among the three sections of the state are shown in the rates expressed in Table 1. The

rates for the East and the Middle Tennessee groups show significant variations, the differences ranging from 102.3±8.5 (age 8), or twelve times its standard error, down to 21.4 (age 15), or 1.2 times its standard error, with an average difference, for the combined ages, of seven times their standard errors. Between East and West Tennessee, the differences are also significant, showing a maximum of 107.2±9.7 (age 8), or 11.1 times its standard error, and a minimum of 41.5±20.6 (age 15), or twice its standard error, and with a mean difference for all ages of seven times their standard errors. The differences between the Middle and the West Tennessee rates, however, are not statistically significant, on the whole, showing a maximum of 43.3±8.3 (age 10), or 5.2 times its standard error, and a minimum difference of −3.5±8.4 (age 12), or 0.4 times its standard error, with an average difference for ages 6-15 years of only 1.7 times their standard errors.

Correlated Data.—Some of the major environmental factors described in the dental literature as having a relationship to regional variations in dental caries rates were also investigated to determine whether they show any correlation with the findings as reported for the three geographic sections of Tennessee.

The climatologic data, reported by the U. S. Weather Bureau[2] for each of the three sections of Tennessee, were summarized for a twenty-year period, 1920-1939, to derive the number of clear, partly cloudy and cloudy days per year, as an index of the relative amounts of sunshine enjoyed by the populations of East, Middle and West Tennessee. The results of these tabulations are shown in Table 2.

It will be noted in these comparisons that East Tennessee, during a twenty-year period, has reported on the average the least number of clear days per year (145.7) and the greatest number of partly cloudy (105.9) and cloudy (114.0) days per year. West Tennessee shows the greatest number of clear days (178.9) and the least number of partly cloudy (83.0) and cloudy (103.4) days per year. Middle Tennessee stands appropriately between East and West Tennessee, reporting, on the average, 156.5 clear days, 97.1 partly cloudy and 111.8 cloudy days per year, during this period.

These findings are in agreement with the inverse relationship between caries rates and sunshine suggested by various investigators in the past.

The chemical characteristics of the public water supplies of East, Middle and West Tennessee, as reported by

TABLE 3.—CHEMICAL CHARACTERISTICS OF PUBLIC WATER SUPPLIES OF EAST, MIDDLE AND WEST TENNESSEE BASED ON ANALYSES OF SAMPLES FROM 354 SOURCES*

Section of State	Number Water Sources Analyzed	Selected Chemical Content of Waters, in Parts per Million†					
		Carbon Dioxide	Hardness	Alkalinity	Chlorides	Iron	Fluorides
Entire state	354	24.1	82.5	91.5	6.80	0.427	0.142
East Tennessee	165	8.9	85.0	101.5	4.15	0.206	0.123
Middle Tennessee	91	15.1	116.3	111.0	7.40	0.218	0.142
West Tennessee	98	57.8	47.1	58.0	10.80	0.992	0.172

*Hendricks, N. V.: Chemical Characteristics of Tennessee Waters. Unpublished thesis in chemical engineering, Vanderbilt University, 1937.

†Averages of all sources analyzed.

Hendricks[3] from analyses of samples from 354 sources, are shown in Table 3. These data indicate the possibility of inverse statistical relationships between the amounts of carbon dioxide, chlorides, iron and fluorides (all highest in West Tennessee and lowest in East Tennessee) and the caries rates for the three sections of the state. The quantities of fluorides (average 0.142 parts per million), however, and the respective differences by section, are so small that variability of the testing methods might well invalidate any significance that could be assigned to them.

Finally, in connection with various references in the literature to the possible relationship of dental caries to thyroid dysfunction, it is interesting to note that Olesen,[4] in a survey of endemic goiter in Tennessee, reported that the incidence of endemic goiter was greater in East Tennessee than in either the middle or the western portions of the state. Examinations of more than 20,000 white children revealed the incidence of defective thyroids to be 20.2 per cent in East Tennessee; 16.6 per cent in Middle Tennessee, and 14.2 per cent in West Tennessee; the same geographic trend as shown by the dental caries rates for the three sections of the state.

CONCLUSIONS

1. Significant variations in dental caries rates exist between comparable population groups of closely related geographic areas.

2. The dental caries rates among white children, ages 6-15 years, are significantly higher in East Tennessee than in either Middle or West Tennessee.

3. The caries rates among Middle Tennessee children are slightly higher than those among West Tennessee children, but the differences are not statistically significant for most ages.

4. An inverse relationship exists between the relative amounts of sunshine and the dental caries rates in East, Middle and West Tennessee.

5. There is an inverse statistical relationship between certain chemical constituents (carbon dioxide, chlorides, iron and fluorides) of the public water supplies and the dental caries rates for East, Middle and West Tennessee.

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TOPICAL APPLICATION OF FLUORIDE AND FLUORIDE ABSORPTION

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THE discovery by Armstrong and Brekhus,[1] in 1937, that carious teeth have a lower fluoride content than sound teeth has aroused an increasing interest in this relationship. Miller[31] reported in 1938 that the incidence of experimentally produced caries in rats was reduced when fluorides were added to the diet. In the same year, Dean[14] showed that, in areas in which the drinking water contained several parts per million of fluoride, the children had a lower incidence of dental caries than those in areas in which the water contained almost no fluoride. Subsequently, the data on the effect of fluorides on teeth expanded rapidly.

That the incidence of caries experimentally produced in rats can be reduced by increasing the amount of fluoride in the diet has been confirmed in a number of publications.[4, 8, 9, 11, 12, 13, 18, 19, 20, 25, 26, 28, 31, 33, 38, 39] Surveys of children living in areas characterized by high or low fluoride content in the drinking water have been made[14, 15, 16, 17, 27, 30, 32, 35, 40, 41, 45] and these show a negative correlation between the incidence of dental caries and the fluoride concentration of the water.

The chemical relationship of fluorides to enamel, dentin and hydroxyapatite has been studied.[2, 3, 29, 34, 41, 42, 43] The manner in which the fluoride ion influences enamel to bring about a reduction of the incidence of dental caries has not been fully explained. The bacterial flora around the teeth was found to be altered by the ingestion of fluorides,[5, 6, 15, 22] but this has not been accepted as the complete explanation of the mode of action.

Serious consideration has been given to the desirability of adding fluorides to the drinking water wherever it was found to have a negligible or low fluoride concentration. Reports now indicate, however, that it is not necessary to add the fluoride to the diet.[7, 10, 21, 23, 38] The work of Bibby[7] and that of Cheyne[10] are particularly striking. They have shown that the fluoride content of teeth can be effectively increased by direct application of solutions of sodium fluoride to the functioning teeth. Nor should this lead to the undesirable characteristics of mottled teeth. (The poorer durability of mottled enamel[36, 37] may more than offset the lower incidence of caries in such teeth.)

Topical application of sodium fluoride or other fluorides to teeth seems very likely to be adopted as a therapeutic measure to a degree sufficient to warrant consideration of the potential hazard of introducing these materials into the mouth. By carefully rinsing the treated teeth, it should be possible to prevent the ingestion of significant quantities of fluoride. However, it seemed advisable to determine the facts by actually treating the teeth of a human subject according to accepted methods and measuring the extent to which fluoride was ingested and absorbed as the result of the treatment by carrying out analyses[24] of the excreta of the subject.

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Read before the Cincinnati Dental Society, May 1943.

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PROCEDURE

Fluoride was applied to the teeth of the subject by a slight modification of the procedure of Cheyne.[10] To describe it by steps: (1) the teeth were cleaned; (2) a quadrant was isolated with cotton rolls; (3) a saliva ejector was placed in the mouth; (4) the teeth were dried with warm air; (5) an aqueous solution of sodium fluoride (approximately 0.4 per cent) was applied; (6) the teeth were dried with warm air; (7) the solution was applied again and dried as before; (8) the area was irrigated with water, which was carried away by the saliva ejector, the cotton rolls being removed meanwhile. The same procedure was repeated in other areas until all the teeth had been treated. The entire application required 1-2 ml., equivalent to 2 mg. of fluoride. This quantity may be presumed to approximate the maximum quantity available for ingestion from a single treatment if none of the solution was removed by irrigation. This procedure was repeated on five successive days. The urine and feces of the subject were collected in 24-hour samples for a period of one week before the topical applications began, and, from then on, for four additional weeks.

FLUORIDE CONTENT OF URINE OF A HUMAN SUBJECT FOLLOWING TOPICAL APPLICATION TO THE TEETH

	Range of Output Mg.	Average Daily Content Mg.
7 days, period before treatment	0.22-1.11	0.666
5 days, period of treatment	0.17-0.99	0.554
23 days, period after treatment	0.35-1.05	0.562

RESULTS

The analytic data on the urine of the subject are given in the table. Although the average excretion in the urine appears lower during the treatment period, the difference between this and the averages for the other periods has no significance. The individual values for the five daily urine samples were all within the range of variability of the samples for the entire five-week period. The average daily fluoride content of the feces was 0.055 mg. Individual results did not exceed the normal range at any time during the period of study.

The amount of fluoride applied to the teeth was sufficient to be detected if any significant proportion of it had been swallowed or absorbed into the circulation on any one of the five days on which the treatment was carried out. The purpose of the repetition was only to facilitate the detection of any absorption that might occur either from summation or as the result of slight variations in the procedure from day to day.

CONCLUSIONS

The therapeutic application of a solution of sodium fluoride to the teeth can be carried out without appreciable systemic absorption of the material.

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MOUTH INFECTION IN INDUSTRIAL WORKERS: A SERIOUS MENACE TO GENERAL HEALTH; RESULTANT LOSS TO WAR PRODUCTION

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PART I: SURVEY OF WAR PRODUCTION LOSSES IN RELATION TO GENERAL HEALTH

1. *Sabotage by Accident.*—An FBI official said recently, "With enough industrial accidents, the saboteur does not have to turn a hand. His work is already being done for him."[1]

Rear Adm. William H. P. Blandy, chief of the bureau of ordnance for the navy, said in October 1942, in a talk before the National Safety Council, that one of the deadliest saboteurs is carelessness resulting in costly industrial accidents, and that the accident saboteur is best described by the words "accidents are allies of the Axis," since accidents slow up work in war plants producing material badly needed by our men on the fighting fronts. Admiral Blandy also said that between December 1941 and October 1942, almost twice as many people were killed in this country in accidents than in England by German bombing in three years of war; that the time lost by accidents since December 7 (nine months) was sufficient to have built 100 aircraft carriers, and that accidents are a part cause of the tragic story "too little and too late."[2]

In the following paragraphs, the mass of evidence gleaned from a variety of sources not only substantiates Admiral Blandy's statement, but also stresses the relation of general health to accidents.

The National Safety Council[3] reports that in 1941 accidents cost as many productive man-days as would be required to build sixty-six battleships—nearly twice the known number possessed by the combined American and British navies. Deaths by accident represented labor enough to build twenty battleships, 200 destroyers and 7,000 bombers. Accidents cost $3,700,000,000.00, enough to pay the entire cost of running New York City for six years.

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Read at the Annual Midwinter Meeting of the Chicago Dental Society, February 25, 1943.

William A. Irvin, director of the National Safety Council and former president of the U. S. Steel Corporation, says that accidents are still causing production delays equivalent in the aggregate to a complete shutdown of every industrial plant in the country for a full day each month.[3] The loss annually of more than 100,000 Americans and the injury of 9,000,000 more is a disaster no reasonable person can contemplate with equanimity, and certainly not when every second of time, every ounce of energy, every bit of skill must be put to good use.

Another report from the National Safety Council says,[4] "From Pearl Harbor to November 15, 1942, excluding the African campaign, the armed forces of the U. S. suffered a total of 48,956 casualties, including dead, wounded and those either missing or prisoners. During the same period, casualties to American workers totaled 44,500 in dead alone, while 3,800,000 were wounded." "Casualties on the battlefront are a necessary sacrifice to perpetuate our freedom," said Ned H. Dearborn, executive vice-president of the council, "Casualties on the home front, through accidents, are preventable and hinder the efforts of our fighting men by sabotaging the production of the weapons and matériel of war."

In the report of the National Safety Council for the year 1942,[5] the toll of accidents for the nation is emphasized by a visualization of a great catastrophe in which every man, woman and child in a city three times the size of Chicago was killed or injured.

Robert C. Patterson, Undersecretary of War, reports: "Accidents to workers in the U. S. last year caused the loss of . . . man-days . . . that . . . would represent the closing down of more than 175 plants, each employing 10,000 men, for an entire year."[6]

Four thousand safety industrial engineers, meeting during the summer in Chicago, reported that factory accidents had increased as much as 50 per cent in many centers since Pearl Harbor. Illinois showed a 30 per cent rise.[6]

Donald Nelson, chairman of the War Production Board, states,[7] "Think of it—480,000,000 precious man-days of industrial labor lost last year by reason of accidents—and the figure is going up! This is an intolerable situation."

2. *Sabotage by Illness.*—Accidents are not the only saboteurs of production. The accepted figures for absenteeism from work for 1941 is 400,000,000 industrial man-days lost through sickness alone, exclusive of accidents.[8]

Surgeon General Thomas Parran, of the United States Public Health Service, stated that almost 1,000,000 work years were lost in American industry in 1940 through illness and that a 10 per cent reduction would be equivalent to the production of twelve Army cantonments, five battleships or 16,400 combat tanks.[9]

3. *Losses from Accidents and Illness Combined.*—It becomes obvious, as the evidence piles up, that accidents and disease are as guilty of hindering maximum production as any other insidious form of sabotage.

Public health reports[10] recently stated that, in 1941, more than 10 per cent of workers suffered disabling illnesses and non-industrial accidents causing eight consecutive days or longer absence from work. This high percentage does not include absences under eight days.

The National Safety Council estimates that the costs to the nation of accidents in 1942 was $4,000,000,000. If, as is generally accepted, illness causes seven times as much loss of time from work as accidents, the total economic cost to the nation is almost beyond comprehension.[11]

One authority has said that every day for three years about 4,500,000 men or women have been absent from work because of disease or preventable accidents.[12]

R. R. Sayers, M.D., director, Bureau of Mines, United States Department of Interior, Washington, D. C., declares that,

"As ill health is associated frequently with accidents, a health program in industry would seem at least as important as the safety program that has been stressed so strongly in recent years . . . accidents in industries of the United States cause a loss of approximately 1,500,000,000 man hours of production each year. If the statement is true that illness causes 15 to 20 times as many cases of absenteeism and about 7 times as much loss of time from work as accidents, the seriousness of the health problem in industry is apparent. . . . Data on fatigue and health show the connection between fatigue and loss of working efficiency and increasing accident occurrence."[13]

Adm. Charles W. Fisher, director of shore establishments for the Navy, says,[14] "War plant casualties are as important as war front casualties."

Brig. Gen. Donald Armstrong, head of the Chicago Ordnance District, in a radio broadcast in May 1942, said,[15] "The man-hour rate may turn the tide of the whole war. The one point on which Nazi and Japanese Secret Service agents would be most eager to secure data is probably the rate of output per man-hour. More and more, this is becoming a war of machines, and, in a war of machines, the nation that can produce machines in quantity will have all the advantage."

4. *Non-Occupational Losses: the Greatest Menace.*—Thus far in the discussion, the loss of man-hours has seemed to be largely attributed to unavoidable occupational disease and accidents. It is time, then, to correct this impression by examining the evidence further.

C. D. Selby, medical director of General Motors Corporation, reports,[16] in a survey of one group of workers for 1940, that 10 per cent were absent eight days or longer through non-occupational injuries or sickness. The ratio of losses of time from *occupational* diseases and *non-occupational* diseases was 1:300. In the same survey, there were almost twice as many non-occupational injuries as there were occupational injuries. He says, "These figures clearly point to one irrefutable fact: the greatest sources of disability are those with which the public health and the general practice of medicine are concerned."

The following is taken from a statement on medical relationships in industry by the Council on Industrial Health of the American Medical Association[17]:

> Industrial accidents and occupational diseases have received most attention from industrial physicians and hygienists. They are associated with work as *proximate cause* [italics mine], a relationship which has been recognized in workmen's compensation practice. It has been, therefore, to the advantage of industrialists first to seek out means for reducing the frequency and severity of work-related disability. Yet in industry accidents and occupational diseases account for a very small proportion of all time loss by workers to disabling injury or sickness . . . As a rule there will be more sickness among women employees, both as to frequency and extent, and more among married than single women. The principal causes of lost time in industry for men and women both are the diseases and complaints which make up the bulk of general practice everywhere. . . Economically, losses in wages and through disruption in production schedules must be estimated in billions of dollars each year.

5. *Prevention, the Logical Solution.*—"The annual time loss from sickness and accident in normal times is the equivalent of the total manpower of 2,000,000 workers and such a work force today could very well be the difference between attaining the production quota necessary to win the war and failure to attain it." This is a quotation from Holgar J. Johnson, president of the Institute of Life Insurance,[18] who is directing a nation-wide "Keep Well Crusade." Mr. Johnson says further, "Nation-wide emphasis on *preventive* [italics mine] medicine should be heightened. Most accidents and a large part of sickness can be prevented if all possible precautions are taken."

The Council of the British Medical Association[19] has decided that more emphasis should be laid on the preventive aspects of industrial medicine; advocating continuous supervision of the health of the individual worker in his industrial environment.

The Industrial Health Research Board of the Medical Research Council of Great Britain[20] reports that those who are most often ill tend, on the whole, most often to have accidents, and that the prevention of accidents may depend to a considerable degree on the prevention of sickness.

George M. Piersol, in a paper on the rôle of the physician in industry, says,[21] "Although diseases and injuries of occupational origin have long claimed the chief interest and attention of physicians in industry, it is now well established and generally recognized that, in their frequency and importance, *non-occupational* [italics mine] diseases far outweigh those conditions which arise from industry." He quoted an American College of Surgeons survey which indicated that the average employe suffers a time loss fifteen times greater from non-occupational causes than from disease or injury incident to employment, and said further, "The conspicuous rôle of non-industrial disease as a factor in industrial inefficiency is too well known to require further elaboration. . . . In view of the appalling economic losses . . . employers and industrial physicians are evincing an ever increasing interest in the control of such diseases among their employes . . . the well known fact that should never be lost sight of, that industrial medicine is in fact only a specialized part of the broad domain of public health and hygiene and that the most legitimate and constructive activities of the industrial physician should be exerted in the field of *preventive* [italics mine] medicine."

6. *Prevention Emphasized Twenty-Five Years Ago.*—In case it may be thought that medical conservation of the health of employes, especially in its preventive phases, is new, I shall quote at random a few paragraphs from a published article on "Industrial Dentistry and Welfare Work in Illinois" which I wrote in 1917[22]:

In the olden days when men worked alone at their various occupations, the apprentice had the thoughtful care, the consideration, the kindly human understanding and assistance of the man employing him. In those days practically the only banding together of great numbers of men was in the fighting army for the object of destruction and no one ever conceived of the concentration of an army of free men for a single vital commercial purpose with the object constructive in its nature. But today important industrial corporations number their workers by the thousands and the conservation of these people requires stupendous care. Accidents, sickness and other misfortunes become problems of masses and are no longer thought of as individual troubles. . . . But the need of each worker is there just the same . . . the duty and obligation of the corporation does not end when it has provided a place to work, work to do, and the regular payment of a certain sum. It uses up human life and it is, therefore, morally obligated to protect that human life, while it is extracting the serviceable, and after it has left only waste. The employee is more than a means to an end . . . he is also an end in himself. The popular conception at one time was of the soulless corporation: its machinery was not allowed to deteriorate, but the worker received relatively little attention. Men of broad, keen, penetrating vision recognized the injustice and economic waste of it all. Their reasoning was simplicity itself for they stood upon the fundamental principle of the value of the human—a value above property, above institutions, and that the conservation of the thing most valued was the first law of an effective working plan.

It is not necessary to inquire too closely whether industrial welfare work is motivated by desire for profit, by an ideal of national efficiency or simply by human sympathy. . . . Its goal is the health of the worker and one need hardly add that whatever increases the average health of the employee, not only increases the health, happiness and good will

of the individual with his consequent good will, loyalty, and devotion to the firm, but also, through the carrying of this sense of obligation, and sympathy, and interest, from the shop to the home, increases the comfort and happiness of the latter and also of the community. We must not forget to add to all this the consequent increase in the employee's efficiency and productive capacity with the result of increased earnings for the firm. It is a happy moment in the life of a nation which finds so many forces combined in a movement of such paramount value. . . .

Recognizing that health is one of the prime essentials, if not the first requisite of the efficient worker, that it is the easiest thing to lose and the hardest to regain, the aim is to neglect nothing that will contribute to that condition.

This idea of health conservation has spread very rapidly until we find nearly all progressive industrial organizations directing considerable attention to this problem. It has been conclusively demonstrated that activities along these lines, when properly directed, not only reduce illness and accidents and raise the standard of living, but also give direct results in increased efficiency and production.

Health is of the utmost importance and so an attempt is made to preserve the body in good condition rather than to cure it after it is diseased. The cure of disease is of great benefit and has its place, but the financial and the human benefits of increased preventive work are far greater. It is significant that a constantly increasing proportion of the activities of health departments in industry is devoted to education in personal hygiene, health, and prevention.

All of the ideas expressed in these quotations, selected from my earlier paper, were not original by any means. Many had been advanced earlier, and all of them were shared by the majority of physicians then interested in industrial medicine.

7. *Emphasis on Prevention Crystallizing.*—That gradual progress is being made today becomes apparent when we read enumerated in Dr. Selby's report[16] some of the multitudinous agencies, federal, state and medical, that are interesting themselves in advancing industrial health. The American Medical Association has its council on industrial health and has created committees on industrial health in each industrial state. The American Association of Industrial Physicians and Surgeons and many state and local industrial medical organizations are working on the problem.

It is obvious, however, that such progress needs much greater impetus when one reads from an editorial in the *Journal of the American Medical Association*[23]:

Under the pressure of events neither employers nor physicians yet fully comprehend how vast a contribution could be made to the war effort by a well organized industrial health program . . . the dual obligation of educating industry to the benefits of modern industrial health and developing physicians able to respond to this created demand for medical supervision. . . . This process must be accelerated lest some form of compulsory medical supervision be imposed on industry, as has already occurred in England.

The following is from another editorial in the *Journal of the American Medical Association*[24]:

Industry deals with men as well as with machinery and materials. Only recently, however, has industry begun to realize that the man who operates the machine and who fabricates the material is its most valuable asset. As this conviction grows, fostered by both manufacturing and trade associations, employers are beginning to look more and more to the medical profession for assistance in conserving the physical welfare of manpower. Already medicine has, under a variety of circumstances and in all types of industry, so convincingly demonstrated its value in reducing lost time from preventable accidents and diseases that it has come to be considered quite as indispensable as any other of industry's maintenance functions.

8. *Summary of Part I.*—All of the foregoing quotations from various sources lead to the following obvious conclusions:

1. The hope of victory in the present war lies largely in the volume of industrial production.

2. Manpower is the nation's most important problem.

3. The waste of manpower through accident and disease is enormous and intolerable.

4. Only a small proportion of this man-hour loss has occupational causes. The vast bulk is due to disability with which public health and general medical practice are concerned.

5. Most of this waste of manpower can be avoided by intelligent application of preventive medical measures.

6. A well-organized industrial health plan has convincingly demonstrated its value wherever intelligently applied and properly directed. It is indispensable to all industry.

PART II: MOUTH INFECTION IN RELATION TO INDUSTRIAL HEALTH

1. *A Relation Recognized in Industry Twenty-Five Years Ago.*—Throughout this paper, you no doubt have been waiting for me to discuss the relation of mouth infection to the serious health problem in industry. Even before 1917, progressive industrialists realized the import of this relation and acted constructively on this problem, as the following quotation from my previously referred to article indicates[22]:

That part of welfare work which has just recently come to the front and which we are most interested in, is the installation of dental offices for the purpose of encouraging and assisting employees along oral hygiene lines. The reason that Dentistry has come to the front as an aid to health betterment is that only recently has it been conclusively proven and publicity given to the fact that many general body diseases come from disease conditions about the teeth. Health being the prime requisite, anything affecting it is given widespread attention by welfare departments and, therefore, we find that a large number of firms throughout the United States now have Dental Infirmaries and many more are contemplating the placing of dentists in their plants.

Recognition of the detrimental effects of mouth infection as related to the important industrial health problem is, therefore, nothing new or faddish, and I must emphasize this point further by quoting from another published article entitled "Dental Service at the Chicago Plant of Montgomery Ward & Co.," which I wrote also in 1917.[25] This dental department was a five chair clinic, which I inaugurated in 1915.

Every phase of health and its relation to efficient service is of vital importance to large, progressive, industrial corporations in these modern days when "Efficiency" is the watchword. We find, therefore, in medical departments of most of them, well equipped hospitals with physicians and nurses in constant attendance, with the result that there is improvement in health and happiness, and consequent efficiency.

The phase of health that is of especial prominence at present (1917) is the relationship of septic and neglected teeth and mouths to general systemic diseases, and in view of this it is not surprising that special consideration now be given to good dentistry by many large corporations . . . with the resultant installation of dental departments. Of course, this is a step toward greater efficiency, but humanitarian principles play no small part in its conception and execution.

We realize the dangers to health from focal infections around teeth . . . it is realized that the cause of such diseases as rheumatism, heart disease, kidney disease, joint infection, eye infection, neuritis, pyemia, septicemia, etc., has been traced to infections around teeth.

2. *Dr. Mayo's Early Emphasis on the Menace of Mouth Disease.*—It is interesting to note that Charles H. Mayo, of the Mayo Clinic, in 1916, stated[26]: "The next great advance in the prevention of disease, and that wherein dentists are so much interested, is the knowledge that chronic diseases, acute diseases and special local diseases . . . come from mouth infections in the majority of instances."

In 1919, Dr. Mayo wrote[27]:

> Why do we often read or hear of men dropping dead on the street or being found dead in bed, over fifty-three years of age? An enormous number of such deaths were caused largely by preventable conditions, due to the mouth. . . . The chronic recurring diseases of which men die in middle age . . . are due to mouth infection in the large majority of cases.

He also quoted William Block as saying that one-fourth of us have septic mouths at 25 years of age; at 45, nearly 90 per cent are septic, and, after 50, practically all mouths are septic.

As a matter of general interest, Dr. Mayo predicted in this same paper in 1919:

> It is inevitable that medicine will become more or less socialized . . . and justly so, for the care of the children and the care of the poor. Old age, health insurance, workmen's compensation insurance, and pensions will also come, but such organizations are not satisfactory as a cure.

In 1925, Dr. Mayo said,[28] "It is now estimated that about 88 per cent of all deaths, except those due to accidents, are the result of infection."

3. *How Mouth Infection Causes Chronic Systemic Disease.*—Dr. Mayo's assertion of the widespread effects of mouth infection and its high incidence may seem, at first thought, fantastic. When one realizes, however, that such disease may have associated with it not only innumerable harmless bacteria, but also a majority of the most pathogenic organisms known to the bacteriologist, and that the blood supplying the mouth subsequently flows to all parts of the body, one should be able to visualize that, as long as mouth infection remains uncared for, the dangerous germs and their poisons are slowly, continuously and insidiously seeping into the bloodstream and through it to every cell in the body.

Thus, it becomes evident that disease of any tissue of the body can be caused by mouth infection. Sometimes, the direct result may be an acute flare-up of infection in some joint or organ, but more often the result is a slow, gradual and accumulative degeneration of each tiny cell, resulting in general physical and mental changes, changes that cannot be reversed once they have occurred. Such changes also lower tissue resistance to other infections and increase susceptibility to other pathologic conditions. Thus, the indirect effects of mouth infection may be far more serious than the direct effects.

Chronic diseases of the kidneys, heart and blood vessels, including high blood pressure, cause more deaths than any other comparable diseases. Of all deaths in Illinois in 1941, their total was approximately 53 per cent.[29] Disease of these structures seldom occurs suddenly. For example, when one reads of a person in apparent good health "dropping dead" from heart disease, though the failure of the heart was sudden, the cause of the failure was repeated slight or severe infections or the slow, continuous absorption of the products of infection. There is an active substance in the pituitary gland which has a detectable action influencing the tissues of the body if it is present in the ratio of 1 part in 30,000,000,000. Is it very likely, therefore, that bacterial poisons must be in the blood stream in large proportions before they can cause serious damage?

In this discussion of the serious results of absorption in infection, it should not be inferred that all infection originates in the mouth. Toxins may also be absorbed from the tonsils, sinuses, gallbladder or any other place that harbors chronic infection. It is claimed, however, that the mouth is the most common and most prolific source.

4. *Accelerated Aging and Its Industrial Significance.*—Geriontology is the study of the problem of aging. The geriontologist, therefore, should be interested in this discussion because the process of the aging of the functions and capacities of the human being starts at

the age of 25 or earlier, and while the death rate from the acute infectious diseases of childhood is going down, the death rate from the chronic degenerative diseases of maturity is going up. It seems that the latter situation is probably caused by acceleration of aging of the individual cells of the body by degenerative deterioration due to constant absorption of bacterial poisons. Normal aging need not be degenerative deterioration and the diseases of maturity need not be concurrent with normal aging. If no sources of absorption of infection were allowed to exist in the body from childhood on, it should be expected that there would be only normal physiologic aging. A large percentage of adult diseases would, therefore, be prevented and the span of life greatly prolonged.

This should be of interest to the industrial executive as well because the average age of workers is rising. Dr. Selby[16] reports the average age in General Motors Corporation as around 40, an age where the incidence of chronic degenerative disease is becoming alarming. Of further interest to the industrialist is the growing proportion of women employes, since women, being of a more delicate physiologic make-up than men, are more susceptible to disabilities resulting from absorption in infection.

5. *Mouth Infection: A Continuing Menace to Health.*—Although, as I have pointed out previously, the alarming percentage and serious effects of mouth infection were, long before World War I, impressed on the professions and the public, in that war, draft rejections from local mouth conditions were higher than from any other conditions, even though the requirements were entirely inadequate from a health standpoint. This last point is illustrated by a report of the Preparedness League of American Dentists during that war which stated that statistics from hospitals at the front showed that 20 per cent of men in sick wards were there because of diseases arising directly from infections from teeth that were diseased.

In World War II, draft rejections from oral infections are still higher than from any other condition, even after, as one man has said, "Selective Service has relegated mouth health standards to the rubbish heap." If competent mouth examinations were made and adequate standards of mouth health insisted upon, few men could have been accepted until their mouths had been rehabilitated from an infection standpoint. This statement is based on my records as consultant in mouth health and oral surgery to the Chicago Rapid Transit and other companies, which show that approximately 98 per cent of employes examined suffer from oral infection.

6. *Causes Underlying a Continued High Incidence of Mouth Infection.*—One should certainly attempt to analyze why such a serious health menace continues to assume alarming proportions. Probably one explanation is the fact that chronic infection in the mouth seldom causes pain or discomfort and therefore progresses unsuspected. A whole jaw may be destroyed by chronic infection without any discomfort or any exterior indication of trouble, if the process develops slowly enough. In fact, chronic infection, in most parts of the body, progresses to an extensive degree without pain. The lungs may be extensively destroyed by tuberculosis without pain; and many other commonly known examples could be cited. I have quoted here almost verbatim from a radio talk on "Teeth and Health" that I gave in 1928 under the auspices of the Illinois State Medical Society.[30] The fact that chronic oral infection seldom causes pain is, therefore, no new discovery.

The laity, in general, recognizes this possibility in all parts of the body with the exception of the mouth. Here, however, for some reason, people seem to believe that there must be pain and discomfort if there is infection.

Another erroneous notion, similar in

nature, is the almost universal belief that, when one has had all his teeth out and is wearing artificial dentures without discomfort, the mouth must be healthy. A dramatic contradiction of this fallacious belief is found in statistics published by the Mayo Clinic years ago which stated that one out of every three such mouths harbored broken off roots and showed chronic infection, and these statistics are substantiated in our own examinations.

Chronic infection may remain long after teeth have been removed because, when a tooth is diseased, the bone adjoining it is also diseased, and simply removing the tooth does not remove this diseased bone. It can heal over and gradually involve adjacent bone, even to the extent of involving the whole jaw, without causing any pain or discomfort. For this reason, a competent mouth examination always includes regions where teeth have been removed.

Another misunderstanding is based on failure to realize the fact that teeth seldom repair themselves, as do other tissues of the body, when they are injured by accident or disease.

Undoubtedly, another reason for the continuing high incidence of unrecognized oral infection is the existence of several misconceptions on the part of some dentists and physicians as well as the laity.

One of these is the belief that the seriousness of mouth infection is in proportion to its extent. The virulency of the bacteria in a particular region, the kind of poisons that they inject into the system and the resistance of the patient to these particular poisons, rather than the extent of the disease area, are the main and ever-changing factors in determining the seriousness of the infection present. We find, therefore, that one small region of mouth infection, so small that it is likely to be ignored, may be many times more dangerous than a much larger region of infection elsewhere in the same mouth. For example, we may find a serious eye infection showing no improvement on removal of a pulpless, or so-called "dead," tooth, and a large amount of adjacent diseased bone; whereas this same eye infection may begin to show improvement in two hours and clear up completely in a few days on subsequent removal of another pulpless tooth that "shows nothing wrong around it in the x-ray film." Similarly, an acute joint infection may not be benefited by the elimination of so-called pyorrhea involving exceedingly extensive gum and bone tissue around a tooth; whereas this same joint infection may improve spectacularly after subsequent treatment of just a slight degree of inflammation of the gum tissue adjoining another tooth.

The mention of joint infection reminds one of the all too familiar misinterpretation of the facts in arthritis cases. Infection from the mouth instigates an arthritis. The patient takes every treatment known to the profession and to the next-door neighbor. The arthritis continues for, shall we say, five years, until irreparable damage has resulted in the joint tissues and, as a last resort, the mouth infection is then eliminated. Because of this permanent damage, the joint does not return to normal, and the usual conclusion is that the mouth infection was not the cause of the arthritis. If teeth have been removed, the patient has regrets and wishes the teeth were back in the mouth where they could function again for masticatory purposes, not yet realizing fully that these teeth would continue to pour poison into the blood stream with every bite, thus contributing to further disability.

In a similar vein of illogical reasoning is the story of a patient who retained diseased teeth in the mouth for fifty years and was apparently in good health because of marvelous body defenses. The illogical conclusion was that diseased teeth cause no harm to the system, while the facts indicate that for every one as

lucky as he there are thousands in their graves.

Another misconception is the widespread impression that abscessed and pulpless teeth are the only source of mouth infection causing systemic infection and that gum infection including so-called pyorrhea can be ignored; whereas, in my experience, gum infection is as common a source, if not a commoner one.

Still another prevalent misconception is that one can diagnose all mouth infection by the x-ray films alone. These are an important adjunct, and we cannot get along without them, but they are only shadow pictures. They show only changes in bone structure, and not all of these changes, because the shadows of a large percentage of the bone around teeth are hidden by the shadows of the teeth. Whether the changes that do show are due to disease has to be determined by a competent examination of the roentgenograms in conjunction with a thorough mouth examination, a history and an electric test for vitality of teeth. In this connection, it must be emphasized that x-ray negative findings around a pulpless tooth do not indicate that such a tooth is not a source of infection. At least half of all mouth infection occurs in soft tissues, and changes in soft tissues are not revealed by x-ray films unless involvement by disease has extended to the point of causing changes in the structure of adjacent bone tissue. The mouth examination, therefore, must include all the gum tissue around each individual tooth.

Thus, we see that an x-ray diagnosis alone, without a competent oral examination, may constitute a detriment to the health of an individual by seemingly indicating disease when none is present, and by failure to disclose existing disease, which gives the individual a false sense of security. A more detailed discussion of mouth examinations was given in a previous paper.[31]

The greatest misconception of all exists between the individual members of the dental and medical professions as to the significance of the findings of even a competent mouth examination.

7. *The Menace of Mouth Infection in the Apparently Healthy Worker.*—One school of thought contends that, as long as the patient is in apparently good general health, infection in the mouth can be ignored. But I am in agreement with the school of thought which maintains that waiting until local pain occurs or until the general health becomes affected before removing all sources of infection is "locking the barn door after the horse is gone." It may not be too late to clear up local pain or an acute eye infection or joint infection, but it is too late to overcome the resultant degenerative changes that have already taken place in the cells of the important internal organs of the body.

In this connection, I quote from another radio talk given in 1934[32]:

> You may wonder why, if infection is being carried to all parts of the body, it does not immediately cause acute infection in the internal organs. Sometimes it does, but many times such a condition can be present for years before any ill effects are noticed, although, in the meantime, there may be gradual weakening changes taking place in the internal structures.

A common statement by a patient is, "I just had a complete physical examination and I am 100 per cent well, so this infected tooth cannot be doing me any harm." For many years, I have contended that chronic infection from teeth can cause extensive degeneration of the internal organs before a routine medical examination can show anything wrong and, apropos of this, I quote from a paper "Our Present Concepts of Health and Disease; Are They Adequate?" by A. J. Carlson, professor emeritus of physiology of the University of Chicago[33]:

> It is nevertheless a fact that modern medicine has not yet developed diagnostic methods to detect the beginning of injury to,

and depletion of, the great reserves in the human body. . . . Infections, accidents, defective diets, if not the very process of living itself—that is, the process of ageing—do seriously deplete these factors of growth, these factors of regeneration and recovery, these factors of safety, and may deplete them for a long time, before the particular organ or tissue involved is rendered so weak as to break under the strain of living. In other words, the body may be seriously damaged without the individual himself being aware of it in the sense of pain or weakness, but also without the ablest of physicians at present being able to ascertain the same with certainty. . . . Because of growth and regeneration potentials . . . we could lose four-fifths of the liver, nine-tenths of the pancreas, four-fifths of the adrenal cortex, etc., without becoming sick, unless our bodies are under such strains as may occur in serious infections.

Dr. Carlson went on to say that until discovery of new methods of disclosing the reserves still remaining in the human mechanism at any age, we dare not declare any quantity of avoidable poison as safe for man.

Dr. Carlson thus confirms my belief regarding the urgency of eliminating all infection in the mouth, even though the individual is apparently in good health and even though a medical examination supposedly establishes this "good health."

The employe who is constantly absorbing the poisons from mouth infection is experiencing a loss of function of his internal organs and other essential tissues through gradual degeneration. He may be half sick and yet unaware of it. Although statistics have emphasized the serious production losses from absenteeism due to illness, it must be equally stressed that this is only a fraction of the problem. Of far greater import is the fact that, for every employe sick enough to be absent, there are many on the job partly sick and working with greatly reduced efficiency.

E. C. Rosenow, of the Mayo Clinic, in 1940 was quoted by Louie T. Austin[34] as follows:

In summing up my views of the problem at this time, I can do no better than quote the following statement made in 1919: "A sane and comprehensive effort toward the prevention and cure of septic foci in the dental and other areas will result in the alleviation of human suffering, in a better preservation of the tissues in old age, in a longer average duration of life, in increased mental and physical efficiency, in the prevention and cure of acute and chronic disease, and, through the laws of heredity, make for a sturdier race."

8. *Dental Service a Prerequisite to a Complete Industrial Health Service.*—To put all of this knowledge of health conservation to work in this emergency, and to protect employes to the fullest degree, to make prevention of disease a reality and to avoid incalculable loss to employer and employe alike, every industrial concern should provide a complete and competent mouth health service. A partially adequate service is not sufficient, since it is better not to begin than to start in the wrong way. A service that is not the best that can be obtained is liable to do more harm than good and will not warrant support or justify its existence. It must be able to attain the health standards that can be achieved by the thorough application of all available knowledge of the prevention of systemic disease by the elimination of all mouth infection.

The value of an adequate dental department in this connection is readily accepted, and yet inertia, inherent in human nature, has produced a time-lag which has hindered the widespread attainment of this ideal. The industrialist must now bridge this gap.

9. *Additional Values to Industry of a Dental and Mouth Service.*—In addition to the primary function of preventing systemic disease, there are at least four other fields in which a dental department is invaluable.

1. Most people think that almost the only thing that can happen in the mouth is that a tooth may decay or become

"ulcerated" or abscessed and have to be removed, whereas almost every type of non-infectious disease that occurs elsewhere in the body also develops in the mouth and adjoining tissues. A competent dental department will be able to diagnose all such diseases at an early stage, and thus avoid the evil consequences of their neglect, as well as the absenteeism caused thereby.

2. A large percentage of general diseases have mouth manifestations. Among these diseases may be classed the blood dyscrasias, such as anemia and leukemia; the acute infectious fevers, such as scarlet fever, diphtheria and measles; the drug and metal and chemical poisons, such as bismuth, mercury, phosphorus, benzene and lead; the digestive diseases, such as gastritis and jaundice; diseases of the glands of internal secretion, such as acromegaly and Addison's disease; diseases of the nervous system; vitamin and dietary deficiency diseases, and many miscellaneous types of disease. In a paper written in 1916,[35] I named more than seventy-five such diseases with mouth manifestations and pointed to the fact that, in a large percentage, the manifestation in the mouth is the first indication of such diseases. This is notably true of occupational metal poisoning. A competent dental department is able to detect the oral manifestations of many of these diseases long before the employe notices the systemic symptoms which lead him to consult the medical department. Referring such cases to the physician for treatment at such an early stage will result in the prevention of much disability. In instances of occupational disease, a warning to the safety department will result in early preventive measures.

3. A competent dental service will also be able to care for all necessary traumatic surgical conditions around the mouth and jaws. It will be able to recognize cancer of the mouth in its early stages and thus save lives. It will have records that will be invaluable for identification purposes in cases of mutilating disaster. It would be of immense aid to the medical department in the care of the injured in case of any major catastrophe.

4. One of the most important functions of a dental department is health education of employes. How this should be done to the ultimate degree could scarcely be covered in a whole book. Suffice it to say here that it is an uphill struggle to convince people of the importance of prevention and of the ultimate seriousness of common, and apparently slight and simple, disease conditions. But if authentic information is brought to employes persistently, convincingly and in a compelling manner, using all the principles of psychology, advertising and salesmanship, effective and practical results will be obtained.

10. *Confirmation of the Value of Dental Departments in Industry.*—Hart E. Fisher, chief surgeon and medical director, Chicago Rapid Transit Co., says,[36]

> With thirty years' experience in industrial medicine and surgery, it is my firm opinion that mouth hygiene, properly directed, as a preventive measure will be conducive to a marked reduction of industrial absenteeism from illness and injury. Many of the complications, so frequently seen following an otherwise trivial injury or illness, have resulted from tooth and gum infections which were not discovered because only a superficial dental examination, or none at all, was made.

Ernest Goldhorn, in a paper on "Dental Infections and the Industrial Worker," quotes R. J. DeMotte, chief surgeon at the Pullman Plant of the Pullman Standard Car Mfg. Co.[37]:

> From an experience of twenty-five years in industrial medicine, it is my belief that dental sepsis is the most prolific source of ill health among working men. Arthritis, neuritis, chronic infections of the gastro-intestinal tract, chronic infections of the urinary tract, eye infections and often anemia and general debility have definitely been traced to infections about the teeth and re-

lieved or cured by the removal of such infections. I consider the work of the industrial dentist one of great importance in the prevention of loss of time from ill health in an industrial organization.

Dr. Goldhorn also quotes P. J. Brand, director of safety and compensation for the Pullman Standard Car Mfg. Co., which has a remarkable safety record[37]:

From the viewpoint of safety, the very foundation of a well-developed safety program is industrial health, of which dental health care is an integral part. . . . None of these . . . exceeds in importance the plan of employee education and dental health care to keep the employee in better all-around health with increased physical fitness and mental alertness. There is a great need and a tremendous field for more education and publicity to bring industrial management and workers to a realization of the serious physical and mental effects of bad teeth, which contribute so greatly to unsafe practices, inefficiency, material spoilage, production errors and time loss caused by ill health and injury.

Harold A. Hooper, dental consultant, Chicago, Milwaukee, St. Paul and Pacific Railroad, says, in a paper on "Dental Services in Industry"[38]:

No student of the problem of employee absenteeism resulting from non-occupational illnesses can come to any other conclusion than that oral sepsis is a major, if not the major, underlying "root" cause of an astonishing proportion of it.

The industrial executive . . . the president or the operating vice-president must consider what oral antisepsis, insisted upon and maintained among his employees, would mean in more production. If he will give this the same kind of business-like analysis that he gives his other production problems, there will be a great and sudden increase in the number of dental clinics set up in industry.

11. *Summary of Part II.*—1. Mouth infection is a menace to health. It is the most prevalent and prolific source of infection, the underlying cause of systemic disease.

2. Mouth infection continues in high incidence because of various misconceptions regarding it.

3. Preventing or eliminating mouth infection greatly benefits industrial health. This was recognized more than twenty-five years ago and is confirmed by present authorities in industry.

4. A competent dental department in industry embraces various vital functions.

CONCLUSION

In Part I, it was emphasized that the hope of victory in the present war is dependent on industrial production, that the waste of manpower through accident and disease is enormous, that the vast bulk of man-hour loss does not result from occupational disability, but is due to general systemic disease, and that most systemic disease can be prevented.

In Part II, it was emphasized that mouth infection is the major cause of systemic disease, that mouth infection can be eliminated and thus most systemic disease can be prevented, that a competent dental department in industry can attain this purpose and that a dental department has additional values in relation to industrial health.

In consideration of the seriousness of the general systemic effects of all mouth infection, it seems that if an industrial organization is to protect the health of its employes to the fullest degree; if it aims to increase industrial production by preventing the enormous time loss of absenteeism due to disease and accidents, and if it aims to extend to the company the added working years of skilled employes, whom it has taken years of training to develop to their present efficiency, and of executives, the key men, who, through long years of experience, have attained knowledge and judgment that are invaluable to the company and the nation, it must install a competent dental department. It must select a personnel capable of making thorough mouth examinations, finding all mouth infection,

co-operating with the medical department, educating convincingly and bringing to that company and the nation the benefits to health which they have a right to expect.

We must all realize the full implications of the statement of Maj. E. Mann Hartlett, Illinois State Selective Service Medical Director, made in May 1942: "Good health was a privilege yesterday, but today, with every hand needed in the nation's war effort, it is a duty."[39]

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55 East Washington Street.

ARCHITECTURE OF THE SKULL: A PRELIMINARY REPORT

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ARCHITECTURE OF THE MANDIBLE

ACCORDING to Wolff's Law, "Every change in the form and function of bone or their functions alone is followed by certain definite changes in their internal architecture, and equally definite secondary alterations in their external conformations in accordance with mathematical laws."

In order to understand the internal architecture and the external shape of the mandible, it is necessary to study the functions of the muscles acting on it and to understand the stresses that the bone has to withstand.

Only in exceptional circumstances and when a very slight movement is desired does a muscle act alone. Muscles act in groups, and individual muscles exist only as members of a group. In describing the action of a muscle, it is important to remember that its function depends on its place in the group and on the actions of the other members of the group.

The primary function of the muscles of mastication is to make the actions of the teeth possible. In some animals, the teeth, in cutting food, act as scissors or shears, as in the cat. Some animals use their teeth to gnaw, and, in man, teeth are used mainly to grind or mill food. Members of different species make varied functional demands on their teeth, and the shape, size and disposition of the muscles of mastication vary according to these functional demands. With the necessary changes in the muscular arrangement, there are the equally important changes in the architectural design of the jaw bones.

Before discussing the architecture of the mandible, it might be well to consider stress and stress lines as they occur in engineering. A beam, supported in the middle and loaded at each end, will tend to bend into an arc; and, in this condition, its upper surface is stretched or in a state of tension, while its lower surface is in a state of compression. In such a beam, stress is greatest above the point of support; the intensity of the stresses progressively diminishing on each side of the support as the loaded ends, at which there is no stress, are approached.

In the middle of the beam, there is a neutral zone called the neutral axis. (Fig. 1.)

The mandible of a cat can be likened to the loaded beam. The condyle acting as a hinge forms the point of support, the temporal muscle at one end and the resistance of the teeth at the other end representing the loads. (Fig. 2.)

The functional arrangements of the muscles of mastication I have described in the JOURNAL for July 1940.

The lower jaw of the cat and of man are used to demonstrate the architecture of the mandible.

CHARACTERISTICS OF THE CAT MANDIBLE

The characteristics of the cat mandible are as follows:

1. When the jaws are closed, the pos-

terior teeth do not occlude, those of the lower jaw being completely overlapped by those of the upper jaw.

2. The condyle fits accurately a strongly formed mandibular fossa, which is so constructed that it can resist considerable pressure.

3. Apparently, the temporal muscle is the only muscle solely concerned with closing the jaws. The pull of the masseters is exerted laterally and the cheek

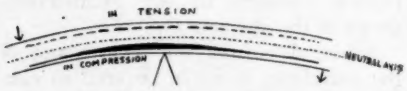

Fig. 1.—Diagrammatic representation of stresses in beam loaded at each end and supported in middle.

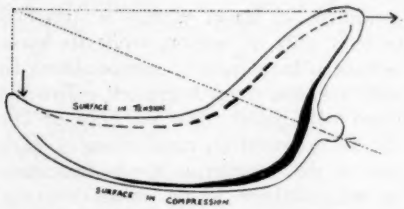

Fig. 2.—Diagrammatic representation of stress lines in mandible of cat.

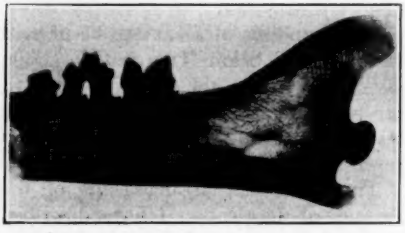

Fig. 3.—Mandible of large cat (lion).

teeth are engaged in their scissor-like action. The pterygoids, if present, are very small.

4. The cheek teeth are placed in the direct line of action of the temporal muscle.

The condyle, which is firmly held in the glenoid fossa, is the point of support.

The temporal muscle is attached to the coronoid process and, being placed well above the condyle, is at considerable mechanical advantage.

Figure 2 shows the upper border of the bone from the coronoid process to the symphysis in a state of tension and serves to describe diagrammatically what is seen in the x-ray photograph showing the architecture of the mandible. The lines of tensile stress extend from the coronoid process to the anterior part of the body, their maximum strength being above the point of support and approximately at the line that represents the

Fig. 4.—Human mandible.

Fig. 5.—Internal architecture of mandible, showing lines of tensile stress.

resultant of two forces: (a) the backward pull of the temporal muscle and (b) the downward thrust from the upper anterior teeth.

In the lower border of the bone, the line of compression is seen, extending from the anterior part through the posterior border of the ramus to the coronoid process, the maximum strength being at the point of support; i.e., the condyle.

In the middle of the bone is the neutral zone; i.e., neutral axis.

Since the function of the teeth in the cat differs from that in man, there must necessarily be a rearrangement in the design of the masticatory apparatus. The rearrangement of the muscles brings about a change in the lines of stress and a reshaping of the mandible.

The position of the condyle, i.e. point of support, has changed relatively to the loads.

CHARACTERISTICS OF THE HUMAN MANDIBLE

The characteristics of the human mandible are as follows:

1. When the jaws are closed, the posterior teeth occlude and prevent the condyles from exerting any pressure on the walls of the mandibular fossa.

2. The temporal, masseter and internal pterygoid muscles all help in lifting the lower jaw to contact the upper jaw.

3. When the opened jaws bite on an object in the anterior part of the mouth, the masseters and internal and external pterygoids hold and support the condyle on the eminentia articularis and thus help the temporal muscle to exert pressure on the anterior part of the mandible.

4. The cheek teeth are placed inside and extend backward behind the line of action of the temporal muscles. (Fig. 4.)

As in the cat family, the lines of stress of the temporal muscle are seen descending from the coronoid process and extending along the upper part of the body of the bone.

From the anterior part, the compression lines descend, curving downward to the lower border and proceeding horizontally backward. At the angle, these lines are seen curving upward to the condyle.

In the body of the bone is seen the delicate framework of the neutral area. (Fig. 5.)

The internal architecture of the mandible is illustrated in dental films of the lower molar teeth. Lines of tensile stress from the temporal muscle cross the molar teeth at right angles, and the apices of these teeth are seen extending into the more delicately formed neutral zone.

As the form and function of teeth vary, so the disposition of the muscles of mastication changes, and the internal and external architecture of the mandible is altered.

The muscles of mastication are so placed that the stresses exerted in the mandible are balanced within the bones in the same way that balance exists in a supported beam.

The mandible then is threaded solidly with lines of stress, and while the action of the muscles upon it remains constant in the individual, its architectural form will remain constant.

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THE JOURNAL *of the*
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August 1 *Editorial Department* 1943

DENTISTRY FOR CHILDREN

ON the broad ground of humanitarianism, it is evident that any activity which relieves our future citizenship of even a portion of the handicap of ill health, of retarded mentality or of physical inefficiency, and helps to make possible a normal, vigorous development, needs no argument for its defense or promotion.

Until two decades ago, when the profession awakened to the importance of mouth hygiene, the point of view and the mode of attack upon dental disease were almost wholly those of treatment of the diseases of the teeth from the reparative standpoint. Many years of effort directed toward control of dental disease from this limited conception brought recognition of the fact that any dental health effort conducted purely from the standpoint of the reparative ideal was totally inadequate to cope with existing conditions. It was realized that the entire manpower and resources of the whole dental profession, even if continuously concentrated upon repair of the damage regularly arising from dental caries, could scarcely make a noticeable impression upon the general progress of the disorder.

Moreover, the attempt to eliminate the evils of dental caries by repairing the results of its ravages after the damage had been done was unsound in principle, and therefore defective in policy, in that it did not strike at the roots of the trouble. Recognition of this fact attracted our attention to the principle of prevention rather than restoration as the one hopeful means of reducing or controlling, if not eliminating, the evils of dental caries. Immediately this principle was recognized, it became evident that its application would be most effective in the early stages of the disease or in the mouths of the young, especially children of school age.

The goal of prevention, however, is so elusive and its attainment dependent on so many and varied conditions, which must first be scientifically considered and settled, that our present course appears to be to divide our efforts between research for solution of these puzzling problems and provision for the immediate dental needs of humanity.

As the search for the various causative factors of dental caries progresses, it is apparent that the solution of the problem lies far back in the life cycle of the individual, and that care of the teeth of children is the most logical and promising step that we can take at present toward the goal of prevention.

The profession, in pursuing the restorative motive, appears to have forgotten the child and the fact that even restorative means are more effective in the beginning stages of childhood. Studies on dental caries have redirected our efforts toward the preventive approach, but it required a concerted plan to direct the effort to the care of the teeth of children as the most practical approach to prevention in the present state of our knowledge. Experience gained in combating dental disease in children emphasizes the necessity for dental care long before the aching tooth demands the attention of the dentist—and dental care for the child in its early years holds forth the promise of untold benefits to the coming generations, even though such care may appear to be too late from the preventive standpoint to benefit the present generation.

The futility of attempting restoration of all the teeth that need it and the absence of any promise of immediate fulfilment of the hope of prevention have developed a new conception of the mission of dentistry. This new conception has become the animating motive of a group of practitioners, who have banded themselves together as the American Society of Dentistry for Children.

The purpose of the American Society of Dentistry for Children is the

advancement and dissemination to the profession and public of knowledge of all phases of dentistry for children; in particular, its relation to general health.

The society was organized in 1927 by a group of dentists who have taken their declared dental aims and purposes seriously and have done much to promote dentistry for children even in the face of a retarding indifference on the part of the profession generally.

Among other efforts, the society has published its own journal for several years and has aroused sufficient interest in dentistry for children that courses in pedodontia have been established in many dental schools, leading many in the profession to specialize in the treatment of children's teeth. This association has had much to do in directing more definite and organized attention to the teeth of school children through the teachers of the schools. In this regard, however, considerable difficulty has been experienced in getting cooperation from the school authorities in assigning desirable hours for care of the children by the dentist. The custom has developed of limiting the time for dental attention to after school hours, and this has been a more or less serious handicap in procuring proper dental care for the children. The after-school hours are hours that are indeed trying to the child who has spent the day in school and is more or less tired, restless and nervous. The dentist who has devoted the day to his usual practice routine is also more or less tired, restless and nervous. It is apparent that satisfactory services cannot be rendered under such unfavorable conditions.

The pedodontists are endeavoring to correct these conditions by obtaining more consideration from the school authorities to the end that the children may have appointments in the early part of the day without detracting from their school standing. In some sections, the school authorities have been inclined to correct these unfavorable conditions, and we would call special attention to the helpful attitude of one school superintendent who has long been a friend of dentistry and in cooperative sympathy with all efforts to render adequate dental service to the school children. We refer to Dr. Willis A. Sutton, superintendent of the Atlanta Public Schools, whose attitude toward dental care of school children is exemplified by an insistence that those teachers and principals under his direction cooperate with the parents who desire their children to receive dental attention during favorable hours of the day, and that the child shall not be penalized by an absent mark or discouraged from consulting the dentist during school hours.

Dr. Sutton is quite familiar with the amount of dental care needed by school children and with the physical impossibility of adequate dental service being rendered in after-school hours.

Probably the main deterrent to dentistry for children is the disinclination and even dislike on the part of many dentists to "bother" with children's teeth because of the difficulty in handling children and, too, because of the impression that greater remuneration comes from care of adults. If the latter reason is true, it is a negation of our professed humanitarianism and a discredit to dentistry. In fact, the intentional avoidance of practicing for children is contrary to the service ideal of dentistry and denies the claims of dentistry as a worth while health service to the public.

The time for beginning intelligent care of the child patient is as early in childhood as the parent can be induced to bring the child to the dental office. It is then that the child's mind is most impressionable, and it is then that seeds of knowledge and appreciation of the value of teeth may be planted that will in later years bear a hundredfold. So far as the teeth are concerned, educational efforts are more productive of good results at this impressionable age than at any other. Proper care of the child will avoid that bugbear, pain, which is more responsible for tooth neglect than all other conditions.

As to the pain aspect and the difficulty of handling the unwilling child, the men who began to specialize in dentistry for children two decades ago have solved that problem quite satisfactorily. The pioneer work that has been done in this phase of dentistry is well presented in the textbooks and lectures on the subject by leading pedodontists.

But the question arises as to how the child can be brought under the care of the dentist. That is an educational problem within the scope of every practitioner. It is true that pain is the principal impulse that drives the child to the dentist and, curiously enough, it is this inherent fear of pain that creates almost insurmountable difficulties when he arrives. But the child's attitude and the adult's attitude toward the dentist, and indeed the future welfare of the dental apparatus, are determined by these first impressions of the dental office and the operator. It is with the child that education in mouth health must begin, and here is the most valuable asset to the dentist in building practice for the future.

Another important phase of dental care for children is its economic aspect. We are conversant with the economic value of mouth hygiene care as administered to school children by the school hygienists, and we

are also familiar with the fact that the damages from disease are cumulative and may best be avoided by correcting the first inroads in the first years of dental disease.

The hope of the future in dentistry is prevention, and the success of our efforts at prevention, it seems to us, will be in direct proportion to the age at which the disease, dental caries, is brought under control.

THE DENTAL PICTORIAL

FOR many years, or since the realization of the value of mouth hygiene as a dental and general health measure, the profession has appreciated the desirability of publicizing dentistry to the public, and various methods and means to that end have been tried at various times. However, any thought or suggestion of publicity which in any way savored of modern methods of publicity as pursued in the business world has been frowned upon as unethical and beneath the dignity of the dental profession. In fact, we have been so ethically strait-laced and dignified in this respect that we have tended to lean over backwards.

There is not the least doubt that this attitude has been a distinct retarding influence on efforts to promote the benefits of mouth health in all its phases, encouraging and frequently compelling certain classes of the public to obtain their information on dental health subjects from questionable and unreliable sources. Just why this unreasoned prejudice against "blowing our own horn," as it were, exists is a paradox; for what is of greater importance to the public than a knowledge of ways and means of maintaining health and recovering it once it has been impaired? Any and every legitimate means of promoting mouth health is justified and even demanded in forwarding our professional humanitarian motives.

The Constitution and By-Laws of the American Dental Association states that one of the objects of the American Dental Association is to disseminate knowledge of dentistry and dental discoveries; to enlighten and direct public opinion in relation to oral hygiene, dental prophylaxis, and advance scientific dental service.

The Association has long recognized its obligation in this respect, and, for years, through its Bureau of Public Relations, in cooperation with its Committee on Public Health and Education and, more recently, through

its newly created Council on Dental Health, it has used every available avenue or channel to bring dental health messages to the public.

Dental health educational material in the form of leaflets, pamphlets, booklets and other printed matter has been prepared and distributed not only to the members of the profession, but also to educators, public health workers and the public at large.

Motion pictures and stereopticon slides on different aspects of dental health are furnished by the Bureau to dental societies, individual dentists and lay organizations.

The radio has been used extensively both locally and on national networks. Radio programs ranging from the short lecture to the dialog, dramatic presentations and electrical transcriptions are available for the use of dental societies over their local stations.

The use of newspaper publicity has been developed extensively within recent years, so that the newspaper columns and, to a lesser extent, magazine pages carry interesting and informative articles on dentistry, emanating from the Bureau of Public Relations.

There is no doubt that the constant stream of diversified educational material emanating from the Bureau of Public Relations through these channels has had a direct influence on the dental health of the American public.

The most recent public educational endeavor undertaken by the Bureau of Public Relations, in cooperation with the Council on Dental Health of the American Dental Association, has been the launching of *Dental Pictorial,* a small, well-illustrated magazine for distribution to the public. For years, there has been a demand on the part of many of our members for a magazine of this kind. Four years ago, at the Milwaukee meeting, the Committee on Public Health and Education first seriously considered a magazine of this nature. Careful and thorough study of the project indicated, however, that its promotion and development involved more expense than could be borne by the Bureau's budget. Last year, a plan was developed whereby one of America's largest publishing houses agreed to publish such a magazine and assume all of the financial obligations. The proposal was approved by the Board of Trustees and the House of Delegates of the American Dental Association at the St. Louis meeting, August 1942, and the Bureau of Public Relations immediately took initial steps to make what has long been a dream a reality.

The purpose of *Dental Pictorial* is to bring to the public in an interest-

ing manner a constant stream of diversified dental educational material. The publication will be issued bimonthly, and the material will be constantly changing. Thus, interest on the part of the subscriber or reader can be sustained.

Just as the Constitution and By-Laws stipulates that it is one of the duties of the American Dental Association to educate the public, so also is it one of the duties of the individual members of the Association to aid in carrying that message forward. *Dental Pictorial* is the Association's publication. It is the dentist's publication, and its success will be in proportion to the use made of it by our members.

Dental Pictorial has a potential minimum circulation of at least half a million copies, which can easily be reached within the first year if every member of the Association will subscribe for an average of ten subscriptions. One or two of these magazines can be used in the dentist's waiting room. The others should be mailed to influential people within the dentist's community. The Bureau of Public Relations recommends that individual dentists, as well as dental societies, distribute the magazine to educators, public health officials, nurses and physicians (particularly pediatricians), as well as to persons of prominence and influence among their own patients. Thus, if every dental society and every member of the Association will contribute toward the promotion of *Dental Pictorial,* it can be made a potent factor in raising the dental health standards of the American people.

BIBLIOGRAPHICAL

Periodontia. A Study of the Histology, Physiology, and Pathology of the Periodontium, and the Treatment of Its Diseases.

By HENRY M. GOLDMAN, D.M.D., Instructor in Oral Pathology, Harvard School of Dental Medicine, Harvard University. 310 illustrations, including eighteen in color. St. Louis: C. V. Mosby Company, 1942. Price $7.50.

THE author has divided the subject of periodontia into five parts and has devoted one chapter to each.

Chapter I deals with methods of examination, including exacting clinical and laboratory tests that are frequently necessary to determine the relationship between some systemic disturbances and periodontal diseases. This information is distinctly valuable to the operator, even if not used regularly in routine treatment.

Chapter II, on diagnosis, is excellent and well supplied with photographs to illustrate cases.

Chapter III, on etiology, is complete, the text well supported by references to many authors, especially when a difference of opinion may exist.

Chapter IV, dealing with histology, physiology and pathology, is a general discussion of the pathologic changes in the periodontal tissues in various disturbances to which these tissues are susceptible.

Chapter V deals with treatment, including scaling, surgical treatment, medication, stimulation and stabilization of teeth with weakened supporting tissue.

The book is well written and has many features that make it attractive. The illustrations are very good throughout the text. The references to the literature are extensive and give the text a good background for statements made. It is rather unusual to have the diagnosis of all conditions in one chapter and a general discussion of them all in another chapter, but this saves the reader some time in forming a mental picture of different periodontal conditions, though perhaps not giving him quite such complete knowledge of these conditions as if they were treated as a whole in one place.

The book represents a wide study of periodontia and a careful selection of clinical material, which has been well photographed.

This text should be widely read as a valuable contribution to the library of dental textbooks.

EDGAR D. COOLIDGE.

Textbook of Periodontia (Oral Medicine).

By SAMUEL CHARLES MILLER, D.D.S., F.A.C.D., Associate Professor of Periodontia in charge of Periodontia Department, New York University College of Dentistry; Lieutenant, Dental Corps, United States Naval Reserve (Special Service), with the cooperation of the members of the Periodontia Staff of the New York University College of Dentistry; W. Wolf, M.D., M.S., Ph.D., Medical Consultant, and an introduction by John Oppie McCall, A.B., D.D.S., F.A.A.P., F.A.C.D., Director, Murry and Leonie Guggenheim Dental Clinic, and fifteen special contributors. Second edition. 733 pages; 503 illustrations, many in color. Cloth, price $9.50. Philadelphia: P. Blakiston's Son & Company, 1943.

WHEN the first edition of Samuel Charles Miller's "Textbook of Periodontia" appeared (1938), it was considered noteworthy because of its completeness and detail, yet in the last four years so many valuable new findings and improvements in technic of treatment have become available that a revision of the book was required. For example, no mention was made in the first edition of gingival hyperplasia caused by the use of dilantin sodium, for this drug had not been used widely at that time. In the second edition, four colored pictures of this condition, as well as discussions in the text, are included. Many other additions have been made and several sections reorganized and

rewritten. As in the first edition, clinical descriptions and discussions of treatment are featured in this book. The author spends perhaps too little space on such subjects as theories of etiology of calculus formation and the histopathology of the periodontal disorders, preferring to emphasize the clinical aspects of periodontia. More than 500 illustrations, many of them new, appear in this edition. A series of questions is given at the end of each chapter to aid the student, teacher and reader in summarizing the contents of the chapter. Good bibliographies are appended to each chapter and a fifty-eight page glossary of medical and dental terms may be found in the back of the book.

The illustrations are well reproduced and, with the excellent printing and attractive blue cloth binding, make up an outstanding volume. Every general dentist at all interested in periodontia will profit by reading this book.

M. K. H.

Practical Orthodontics.

By MARTIN DEWEY and GEORGE A. ANDERSON. Sixth edition. St. Louis: C. V. Mosby Company, 1942.

THE current edition of "Practical Orthodontics" by Dewey and Anderson is the outgrowth of a volume by Martin Dewey published in 1914.

The present prominent position of orthodontics in dentistry and its importance as an influence for health and happiness are the result of the rapid development and progress of the specialty during the past quarter century. During this period, valuable research in dental and allied fields of science has added much to our knowledge of growth and development, resulting in a better understanding of orthodontic problems. New materials have been provided and improved types of mechanisms and new methods of therapy are now employed in modern orthodontics.

George M. Anderson, a capable clinician and teacher, is to be complimented upon his ability as an author in producing this excellent textbook, which contains 559 pages and hundreds of excellent illustrations. There is a chapter on "The Field, Definitions, Objectives and Benefits of Orthodontics." This is followed by a rather comprehensive historical review, written by B. W. Weinberger. The author writes of "Occlusion of the Teeth," "Malocclusion," "Etiology of Malocclusion," "Diagnosis" and "Differential Diagnosis." There is a chapter on "Measurement of Dentofacial Changes in Relation to the Cranium," by B. Holly Broadbent; a chapter on "Extraction in Its Relation to Orthodontic Treatment," by H. E. Kelsey, and a chapter by Rudolf Kronfeld on "Tissue Changes Incident to Orthodontic Tooth Movement."

Dr. Anderson has produced a valuable treatise which adequately covers the various phases of orthodontics and in which he wisely has included the ideas of many students of orthodontics and collateral subjects, and he has explained with thoroughness the use of the principal types of appliances and the methods of treatment now in favor.

Dr. Anderson takes up the problem of corrective treatment, including chapters by Alfred P. Rogers, on "Myofunctional Treatment of Malocclusion"; E. W. Swinehart, on "Orthodontic Bands," and Chester F. Wright, on "The Edgewise Arch Mechanism."

There are comprehensive chapters on the treatment of malocclusion and on retention. The book contains twenty-two chapters, the final one being on "Plastic Surgery of the Jaws" by Edward A. Kitlowski. Other contributors to the text are Sidney E. Reisner and E. B. Arnold.

This plan is in contrast with that of books that are devoted to one particular theory of therapy. Each chapter is replete with information and logical comments, which evidence the long experience, careful study and good judgment of the author. The book is a valuable addition to dental literature.

C. R. B.

BOOKS RECEIVED

A National Plan of Re-Education for the Control of Dental Disease Through Prevention.

By DAVID FRIEND, Executive Director, The New Organization. Published by The New Organization, Inc., 9 East 40th Street, New York, N. Y., 1942.

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WAR SERVICE COMMITTEE

DEFERMENT OF INTERNS

To the Deans of Dental Schools:

It has specifically been called to the attention of the War Service Committee that, owing to the current and future need for dentists by the armed forces and in civilian practice, it will obviously be difficult for our great dental institutions dedicated to the care of the children of the nation to obtain interns and thus operate as efficiently as heretofore.

The Committee has reference to the Eastman Dental Dispensary, 800 East Main St., Rochester, N. Y.; the Forsyth Dental Infirmary for Children, 140 The Fenway, Boston, Mass., and the Murry and Leonie Guggenheim Dental Clinic, 422 East 72nd St., New York, N. Y.

The United States Navy, in certain instances, has permitted recent dental graduates holding Navy commissions to enter upon an internship in these institutions, pending call to active duty, and some physically disqualified man and woman dentists have been accepted as interns. The Army, under its regulations, has not been able to make deferments of recent dental graduates holding an Army commission as every dentist commissioned must immediately be sent to active service. It is believed that Selective Service may give consideration to the deferment of a limited number of dentists who are accepted for internships in these institutions, as evidenced by the communication dated June 24, 1943, signed by Col. C. G. Parker, Jr., deputy director (quoted below), and it is hoped that those charged with the deferment of these men or with the recommendations in connection therewith will give serious consideration to this matter to the end that the essential service rendered to the public by these institutions dedicated to the care of underprivileged children may be maintained.

National Headquarters
Selective Service System
21st Street and C Street, N.W.
Washington, D. C.
June 24, 1943

Dear Doctor Camalier:

Reference is made to your letter of June 21, 1943, addressed to Capt. C. R. Wells, USNR, concerning the shortage of dental personnel in certain large dental clinics.

If the Eastman Dental Dispensary, Rochester, N. Y.; the Forsyth Dental Clinic, Boston, Mass., and the Murry and Leonie Guggenheim Dental Clinic, New York, N. Y., are recognized as essential institutions by the authorities in the communities in which they are located, representation should be made to the state director of Selective Service in the states in which the Forsyth and Eastman Dental Clinics are located and to the New York City director, Selective Service, in the case of the Guggenheim Dental Clinic, to acquaint these officials with the number of dentists required to maintain the institutions.

Every effort should be made to staff these institutions with dentists who are not available for the armed forces before representation is made. A complete personnel analysis, together with a replacement program, should be submitted to the Selective Service officials.

Existing Selective Service regulations and policies provide guidance for state directors in such cases as your communication refers to and this headquarters does not feel that additional provisions are necessary.

It is requested that the deans and others will keep the foregoing institutions in mind when advising recent graduates interested in dental internships. Dentists making application should consult their local boards and request assistance from the Procurement and Assignment Committee dental chairman in their respective states concerning

deferment for these essential institutions.

Deferment requests for these establishments should be made on the basis of "graduate dentists for essential institutions" rather than "dental interns."

Trusting that you will give most careful consideration to this matter, I beg to remain

Sincerely,

C. WILLARD CAMALIER, *Chairman.*

POLICY OF NATIONAL SELECTIVE HEADQUARTERS ON PREDENTAL STUDENTS

To the Deans of Dental Schools:

THE War Service Committee quotes below the policy of National Selective Service Headquarters, on predental students, forwarded under date of June 24 in reply to a specific inquiry from this office:

A student graduating from high school and entering predental work at college level will be entitled to consideration for occupational deferment under Activity and Occupational Bulletin No. 33-6 if both of the following certificates can be provided:

(a) A certificate by the predental institution showing that he is a full-time student in good standing and certifying that if he continues his progress he will complete his predental course on or before July 1, 1945.

(b) A certificate of a dental college that he has been unqualifiedly accepted for admission and will undertake professional studies upon completion of his pre-professional work.

At such time during his predental studies if the predental school can and does make such certificate and the dental school accepts the student and so certifies, he may be considered for occupational deferment. The predental school may make its certificate on the high school record of the student and such ability as they have observed after his entrance in the predental work.

If a student in pre-professional studies discontinues his studies or fails to make an acceptable academic standing, the dental school will be relieved of its responsibility upon proper notification to the Selective Service local board that it has withdrawn its acceptance of the student.

Sincerely,

C. WILLARD CAMALIER, *Chairman.*

NATIONAL DENTAL SALVAGE COMMITTEE

GRATITUDE to the Dental Association for its response to the plea for scrap has been expressed through Henry A. Swanson, chairman of the Dental Association's Salvage Committee, by W. R. Talbot, chief of the General Salvage Branch of the Salvage Division, War Production Board.

In thanking Dr. Swanson, Mr. Talbot said, "No other group has responded more unanimously to the nation's salvage drive than the dentists. We want all of them to know that the Government considers their scrap donations extremely worth while." Mr. Talbot again stressed the need for copper scrap and asked that dentists continue to make as much of it available as possible for war purposes.

Dentists are requested to continue their collections of iron, steel, tin, bronze and brass scrap. All of these items, Mr. Talbot said, are still greatly needed to aid the war effort.

It further was pointed out that the collection of scrap rubber is now being somewhat subordinated to other salvage needs. The amount accumulated as a result of the recent scrap rubber drive is sufficient for immediate needs. As this may prove to be a temporary condition, dentists are urged not to destroy any rubber in their possession, but to hold such stores for future disposal.

BUREAU OF PUBLIC RELATIONS

ENDEMIC DENTAL FLUOROSIS OR MOTTLED ENAMEL*

As early as 1901, J. M. Eager,[1] passed assistant surgeon of the U. S. Marine Hospital Service,† reported defective calcification of the permanent dentition of certain emigrants from Italy, particularly those people coming from Pozzuoli, a community about 5 miles from Naples. In 1916, Black and McKay published a series of articles in *Dental Cosmos* reporting the first thorough investigation of this enamel defect. Black[2] introduced the term "mottled enamel" to describe this condition, and according to his records, "The teeth are of normal form, but not of normal color. When not stained brown or yellow, they are a ghastly, opaque white that comes prominently into notice whenever the lips are opened." The term "mottled enamel" as used by Black was meant to describe the more severe types of the disease. The term "dental fluorosis" seems more appropriate in speaking of all types of the disease. The epidemiologic studies of McKay pointed unmistakably to dental fluorosis as a water-borne disease and sharply limited to certain endemic areas. Fluorine as the etiologic factor was not reported until 1931. At this time, independent investigations of Churchill,[3] Smith and others[4] and Velu and Balozet[5] pointed to fluorine as the probable causative agent.

From the Division of Infectious Diseases, National Institute of Health, Bethesda, Md.

†Now the U. S. Public Health Service.

*The growth of public interest in dental health has resulted in a marked increase in requests for information on different phases of the subject. To meet this demand, the Public Health and Education Committee, now a committee of the Council on Dental Health, has authorized the preparation of a series of articles in pamphlet form, each article to deal with one of the dental questions most frequently asked by the public. The current article, "Endemic Dental Fluorosis or Mottled Enamel" by H. T. Dean, D.D.S., and F. A. Arnold, Jr., D.D.S., dental surgeon and passed assistant dental surgeon, respectively, of the U. S. Public Health Service, can be obtained in reprint form at a nominal cost by addressing the Bureau of Public Relations, American Dental Association, 222 E. Superior St., Chicago, Ill.

PREVALENCE

Since 1931, investigations concerning the prevalence of dental fluorosis have become world-wide. A large part of the work has been done in this country by the United States Public Health Service. At the present time, there are in the United States about 400 areas in twenty-eight states where "mottled enamel" has been demonstrated by surveys or has been reliably reported. About 79 per cent of these areas are located west of the Mississippi River. (Fig. 1.) Foreign countries where endemic dental fluorosis constitutes a public health problem are: England, Holland, Italy, Spain, North Africa, British India, China, Japan, Mexico, Argentina, Cape Verde Islands, Azores, Bahamas, Canada (Alberta) and certain South Sea Islands.

Attention may be called to the fact that, until recently, the routine analysis of waters by state health departments did not include fluoride determinations. As such determinations are made in the future, new areas of fluorosis may be indicated on the basis of chemical evidence, and subsequent clinical surveys may show a number of new endemic areas, especially areas where the milder types of fluorosis are endemic.

ETIOLOGY

Epidemiologic studies have presented strong presumptive evidence that the causative factor in dental fluorosis is

the ingestion of toxic amounts of fluorine, presumably as a fluoride, in the water used for drinking and cooking during the period of calcification of the crowns of the permanent teeth. These investigations have shown that, in communities where the domestic water supplies contained increased fluorine, the children whose teeth calcified while such water was used for drinking purposes were subject to the disease. Conversely, in communities where the domestic water supply is fluoride-free, the teeth of children born and reared on this water are free of fluorosis. Studies have also been made in communities where the public water supply has been changed from a "high fluoride" to a fluoride-free water. In such cases, the children born and reared on the high-fluoride water show dental fluorosis; whereas those born and reared after the change of water supply are free of the disease.

Experimental studies have shown that by feeding animals a concentrate of the domestic water from endemic areas, changes in the tooth structure similar to those from dental fluorosis in man can be produced. The same results can be obtained by adding sodium or calcium fluoride to the drinking water or food.

Any discussion concerning the etiology of dental fluorosis must also consider the quantitative relation of concentration to effect. Very few waters are absolutely free of fluorides. However, many water supplies have less than 0.2 parts per million (the experimental error of fluorine determinations is about 0.1 part per million), and such waters are commonly called "fluoride-free." On the other hand, some water supplies have been reported with as much as 16 or 17 parts per million. In view of this wide concentration range, the total fluorine intake of individuals using these different waters may vary as much as from 0 to 10 mg. per day.

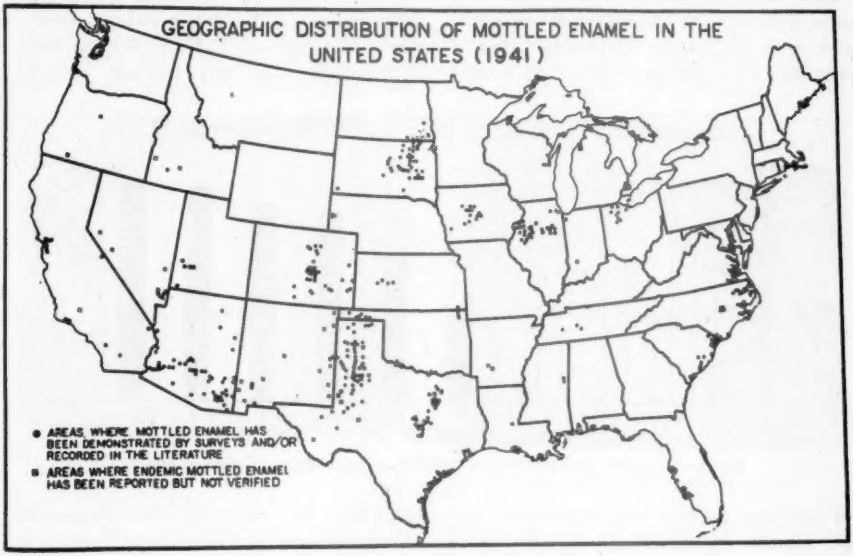
GEOGRAPHIC DISTRIBUTION OF MOTTLED ENAMEL IN THE UNITED STATES (1941)
• AREAS WHERE MOTTLED ENAMEL HAS BEEN DEMONSTRATED BY SURVEYS AND/OR RECORDED IN THE LITERATURE
▪ AREAS WHERE ENDEMIC MOTTLED ENAMEL HAS BEEN REPORTED BUT NOT VERIFIED

Figure 1.

Another important factor in this relationship of concentration and effect is the tolerance of the individual. The same amount of fluorine that causes a

mild toxic reaction in one individual may cause a severe reaction in another. In other words, we are dealing with a low-grade chronic poisoning of the formative dental organ, in which case some individuals may show a more severe reaction than others having a comparable fluorine intake. Differences in drinking and culinary habits of individuals may also cause quite a variation in their total fluorine intake, which in turn will influence the effect.

The above-mentioned factors play an important rôle in the relation of concentration to effect, and thus prognosis with respect to any one individual is obviously unwarranted; but it is possible that a prognosis of a group response to waters of varying fluoride concentrations may be made. Epidemiologic studies have shown that from the continuous use of water containing as much as 1 part per million of fluorine, the very mildest forms of dental fluorosis may develop in about 10 per cent of the group. As the concentration in the water supply increases, there is an increase in the incidence of the affection coincidently with an increase in the severity of the disease in those individuals affected. When the concentration in the domestic water supply approaches 6.0 parts per million, the incidence of the disease in those who use this water throughout life is approximately 100 per cent, about 90 per cent manifesting the disease in the more severe types. A graphic presentation of the quantitative relation of fluoride concentration to clinical effect is shown in Figure 2.

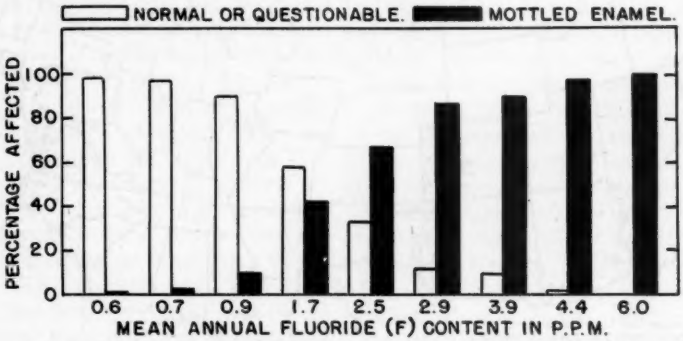

Fig. 2.—Quantitative relation of fluoride concentration to clinical effect.

GROSS PATHOLOGY

Grossly, dental fluorosis varies according to the degree of disturbance in enamel formation. It is essentially a hypocalcification, its milder forms resulting in a loss of interprismatic substance; but, in the more severe types, we find areas on the teeth showing a definite loss of the entire enamel structure. The various clinical pictures seen in dental fluorosis may, perhaps, best be described by restating the diagnostic standards used in different epidemiologic studies.

Questionable.—The enamel discloses slight aberrations in the translucency of normal enamel ranging from a few white flecks to occasional white spots. This classification is utilized in those instances where a definite diagnosis of the mildest form of fluorosis is not warranted and a classification of "normal" not justified.

Very Mild.—Small opaque paper white areas are scattered irregularly over the tooth, but do not involve so much as approximately 25 per cent of the tooth

surface. Frequently included in this classification are teeth showing no more than about 1-2 mm. of white opacity at the tip of the summit of the cusps of the bicuspids or second molars.

Mild.—The white opaque areas in the enamel of the teeth are more extensive, but do not involve so much as 50 per cent of the tooth.

Moderate.—All enamel surfaces of the teeth are affected, and surfaces subject to attrition show marked wear. Brown stain is frequently a disfiguring complication.

Severe.—All enamel surfaces are affected and hypoplasia is so marked that the general form of the tooth may at times be affected. The major diagnostic sign of this classification is the discrete or confluent pitting. Brown stains are widespread and teeth often present a corroded appearance.

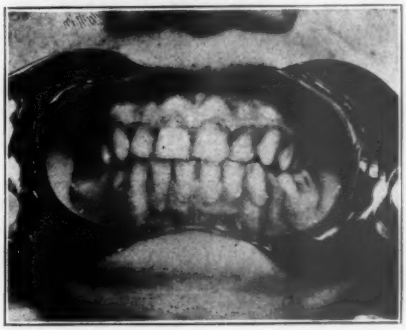

Fig. 3.—Questionable dental fluorosis.

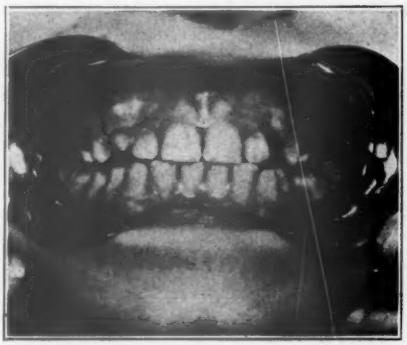

Fig. 4.—Very mild dental fluorosis.

Photographs illustrating these various classifications are shown in Figures 3 to 7.

Attention may be called to the disfiguring "brown stain," which so frequently complicates the moderate and severe types of this disease. This staining process is apparently secondary to the fluorosis itself, as it is absent when the tooth erupts, but appears gradually during the early life of the tooth. The stains usually occur on the more exposed surfaces of the teeth, the labial of upper incisors, but may be found on lingual surfaces of anterior teeth and on molar teeth. At the present time, we have little actual knowledge concerning their etiology.

DIFFERENTIAL DIAGNOSIS

Differential diagnosis naturally must rule out other hypoplasia of the enamel, such as that seen in Hutchinson's teeth, and the hypoplasia concomitant with the exanthematous diseases and nutritional disturbances during the period of enamel development. Endemic dental fluorosis is a chronic intoxication, and the pathologic change resulting from the toxicologic response is readily differentiated from other gross hypoplasia of the enamel by a consideration of the chronology of calcification of the human dentition. Presuming constancy of risk of exposure in areas where the fluoride content of the water is relatively high (2 parts per million or more), the characteristic signs of fluorosis will be distributed through all the teeth irrespective of their different periods of calcification. In areas of lower fluoride concentration, macroscopic fluorosis may not show on those teeth calcified early in life (first molars and incisors), but may become visible on the bicuspids and second molars. Whether this is due to a cumulative effect of fluorine ingestion is not known.

The omnipresent distribution of the affection among all teeth irrespective of the different periods of calcification of the crown is specifically characteristic of dental fluorosis. This phenomenon is in sharp contradistinction to the gross hypoplasia noted on single tooth groupings where the causative factor is ordinarily bounded by certain time limits; the concomitant effect showing only on the teeth calcifying at the particular time of the disturbance.

RELATION TO OTHER ORAL DISEASE

Until comparatively recently, little work was done on the relation of dental fluorosis to other pathologic conditions in the oral cavity. Some authors have called attention to an apparent delay in the eruption of permanent teeth of children living in endemic areas. Other investigators have failed to show any significant difference between endemic and non-endemic areas in regard to the eruption time. There is some indication in the literature that there is an apparent tendency toward a higher incidence of gingival disturbances in areas of relatively high fluoride concentration (more than 4 parts per million).

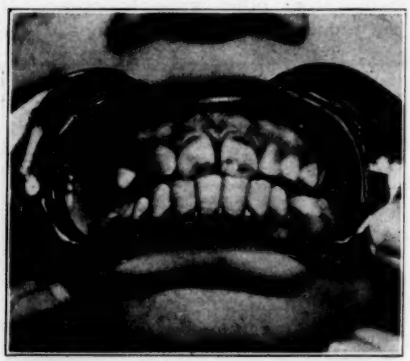

Fig. 5.—Mild dental fluorosis.

In some of the early reports on dental fluorosis, attention was called to the fact that mottled enamel teeth, in spite of their defective structure, exhibited no greater liability to caries than did normally calcified teeth. In the past four years, detailed quantitative investigations have shown that the teeth of children born and reared in endemic areas show much less caries experience than do the teeth of children born and reared on fluoride-free waters. These studies have also shown that this phenomenon is operative in areas where the dental fluorosis is so slight that it is no longer of esthetic importance. This relationship of dental fluorosis and dental caries is one of the most interesting, and probably the most promising, in dental caries research today.

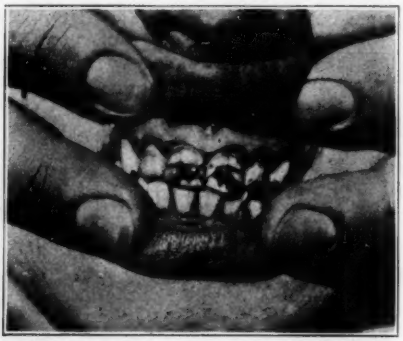

Fig. 6.—Moderate dental fluorosis.

PREVENTION

As was stated above, the continuous use throughout the formative period of the tooth of water containing about 1 part per million of fluorine will result in an incidence of approximately 10 per cent of the mildest forms of dental fluorosis. Thus, the logical approach from a public health standpoint to the prevention of this disease is avoidance of the use of domestic water containing fluorine much in excess of this amount. In some instances, this can be accomplished by simply changing the domestic water supply to a source that is free of toxic amounts of fluorides. Towns that have changed their source of water supply in

order to prevent this condition include Oakley, Idaho, and Bauxite, Ark. Where such changes in the source of water are not feasible, it may be possible, in some cases, especially where the water contains only about 2 parts per million of fluorine, to dilute the water supply with another water to bring the final fluoride content to within permissible limits. In those areas in which a satisfactory water supply is not available, the ultimate solution in such cases would have to depend on a suitable method, economically feasible, of treating the existing water supply by chemical means for the removal of toxic amounts of fluorides. Reduction of the fluoride content, however, much below 1 part per million of fluorine may

Fig. 7.—Severe dental fluorosis.

not be advisable, in view of the recent epidemiologic evidence concerning the low dental caries experience rates associated with the use of domestic waters containing this approximate fluoride concentration.

In areas where dental fluorosis is endemic, the dentist is often faced with the problem of advising parents as to the prevention of this disease in their children. In this regard, it is well to remember that the susceptible period for the development of dental fluorosis is the formative period of the teeth; i.e., the first eight years of life (third molars excluded). For the purpose, therefore, of preventing fluorosis, children under 9 years of age should use for both drinking and cooking: (1) a natural water, otherwise safe, the fluoride content of which does not exceed one part per million; or (2) a treated water the fluorine content of which is about one part per million, or (3) distilled water, cistern water or some other fluoride-free water, combined with fluoride water so that the final fluoride concentration of the mixture is approximately 1 part per million.

Attention is called to the fact that it is necessary to use the low fluoride water for both drinking and cooking purposes during the susceptible period. The boiling of fluoride waters with the hope of decreasing the toxic effect is definitely contraindicated since the fluoride concentration would be increased by such a procedure.

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LISTENING POST FOR CHINA

ALL dentists have the right to consider themselves exceptional in some respect, but Charles E. Stuart, of Ventura, Calif., may without challenge consider himself unique. He is a private citizen holding perhaps the most tremendous communications job on earth, for he is the point of short wave contact between China and America. Well over half a billion people can keep in daily touch with the Pacific war because a California dentist gets out of bed at 6 every morning.

Dr. Stuart, besides being a busy practicing dentist in Ventura, is also the premier radio "ham" of the Pacific Coast. And he is, by official appointment, the Listening Post for the Chinese Government, receiving its daily short wave broadcasts and transmitting them to the Chinese News Service in New York City. The Republic of China chose one of our private citizens for this responsibility, because he was the best man for the job; and he was enthusiastic about drafting himself for this particular service. It is one of those arrangements that only democracies can make and understand.

When we entered the war, China could no longer get news across to us by air mail, and short wave radio was the only answer. Fortunately, the Chungking broadcasting station had survived systematic bombing by Japan. Part of the equipment had been shipped in over the Burma Road. Because of persistent raids, the broadcasting station was finally established in a dugout in the suburbs of the capital, an underground fort of granite 4 feet thick.

On this side, the Chinese News Service made a careful survey to find the optimum spot for a listening post. It was discovered that the steadiest and strongest reception was in Dr. Stuart's radio room, and that Dr. Stuart himself had for years been talking back and forth with Chungking and was willing to continue as an official appointee. All conditions were ideal: the location of Dr. Stuart's house on a sandy beach with no interruption of hills or mountains in the neighborhood, his long experience as a "ham" radio operator, his technical skill *and* his enthusiastic interest in China.

When the first World War began, Charles Stuart started his career as a

Charles E. Stuart, D.D.S., at his "Listening Post" for China.

radio amateur, receiving his first license at 13. He had tuned in on Tibet and Baluchistan. He had followed the *Snow Cruiser* down into Antarctica, and located Howard Hughes at Yakutsk, in the depths of Far Eastern Siberia, during the flier's circling of the globe.

Dr. Stuart's radio room is on the second floor of his home, under a sloping roof. At 6 every morning, with his own conscience for bugler, Dr. Stuart rolls out of bed and trains his mechanical ears to the west. The broadcasting is done sometimes by an American, but more often by a native broadcaster, Peng Lo-shan. The first part of the broadcast is devoted to spot news, which is then repeated more carefully, with the spelling out of difficult names, for the Listening Post. Along about 7, for from half to three-quarters of an hour, there is a longer broadcast, which transmits the texts of speeches or articles and detailed information for use in the various publications of the Chinese News Service.

Chungking allows Chinese and Americans in the capital to send short personal messages to their relatives and friends in America. This is called the Chungking Mailbag. Dr. Stuart is particularly glad to mail out these personal messages, because they are sent on special paper with a request printed at the bottom to send contributions to United China Relief. Dr. Stuart even devotes his evenings to soliciting funds for this cause.

One more all-out record must be chalked up to Dr. Stuart's list: He was the means of getting an entire book from Chungking to the printers in New York. Nothing of the kind had ever been attempted. The Ministry of Information in Chungking had in previous years managed to send the text of its annual war summaries by air mail. Now this was impossible. Somebody had the dazzling idea of using the short waves. The text of a very long book, including tables and statistics of various kinds, was sent out day after day to Ventura and handled in the same way as news. In spite of the bulk and the technical difficulties, the book, "China After Five Years of War," was published late in 1942, in New York, as a thrilling account of what that vast country had managed to accomplish in the last five years, not only in fighting Japan, but also in developing its civil and social programs.

CORRECTION

IN the July 1943 issue of THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION, page 1106, statement (b) under No. 1, Dental Health Education, should read as follows:

"Factual material for use of the schools in the preparation of teaching material has been prepared by the American Association of Public Health Dentists, the American Dental Association and most state health departments."

The name of the American Association of Public Health Dentists was inadvertently omitted from the original article as, too, was the name of Emory W. Morris from the list of committee members.

DENTAL PICTORIAL ITS PURPOSE

Question: WHAT IS THE PURPOSE OF DENTAL PICTORIAL?

Answer: The main purpose of DENTAL PICTORIAL is to educate and inform the reader; contribute dental educational material to schools which will aid in improving the health of American youth, and create a better understanding of the dentist, his work and his contribution to society.

Comment: DENTAL PICTORIAL is a small, 20 page, profusely illustrated, bimonthly magazine. Its subscription price is one dollar for two years. (12 issues.)

Question: HOW CAN DENTAL PICTORIAL EDUCATE AND INFORM?

Answer: DENTAL PICTORIAL can educate and inform by presenting the story of dentistry in such a graphic way that it can be easily understood by every one.

Question: HOW CAN DENTAL PICTORIAL AROUSE PUBLIC INTEREST?

Answer: It can arouse public interest by visualizing in a fascinating way what dentistry has done and is now doing to benefit society and improve health.

TURN TO PAGE A-38 FOR FURTHER INFORMATION ON *DENTAL PICTORIAL*

COUNCIL ON DENTAL THERAPEUTICS

REPORT OF THE FOURTEENTH ANNUAL MEETING OF THE COUNCIL ON DENTAL THERAPEUTICS

THE fourteenth annual meeting of the Council on Dental Therapeutics was held at the American Dental Association Headquarters Building, 222 East Superior St., Chicago, Ill., Friday and Saturday, April 16 and 17, 1943.

The following members of the Council were in attendance:

J. Howard Brown, Ph.D., Sc.D., Johns Hopkins University, Baltimore, Md.

Edward C. Dobbs, D.D.S., University of Maryland, School of Dentistry, Baltimore, Md.

Paul J. Hanzlik, M.D., Vice Chairman of the Council, Stanford University School of Medicine, San Francisco, Calif.

Thomas J. Hill, D.D.S., Western Reserve University, School of Dentistry, Cleveland, Ohio.

Milan A. Logan, Ph.D., University of Cincinnati, School of Medicine, Cincinnati, Ohio.

Arno B. Luckhardt, M.D., Ph.D., Sc.D., LL.D., University of Chicago, Chicago, Ill.

Harry Lyons, D.D.S., Medical College of Virginia, School of Dentistry, Richmond, Va.

Victor C. Myers, Ph.D., Sc.D., Western Reserve University, Schools of Dentistry and Medicine, Cleveland, Ohio.

Floyd D. Ostrander, D.D.S., M.S., School of Dentistry, University of Michigan, Ann Arbor, Mich.

Harold S. Smith, D.D.S., Chairman of the Council, Chicago, Ill.

Donald A. Wallace, Ph.D., Secretary of the Council; Director, American Dental Association Bureau of Chemistry, Chicago, Ill.

The following were present at all or part of the sessions on invitation:

L. Pierce Anthony, Editor, JOURNAL OF THE AMERICAN DENTAL ASSOCIATION, Chicago, Ill.

Howard A. Carter, Secretary, Council on Physical Therapy, American Medical Association, Chicago, Ill.

Stanley W. Clark, School of Dentistry, Northwestern University, Chicago, Ill.

Howard C. Miller, Trustee of the American Dental Association, Chicago, Ill.

Lon W. Morrey, Director, Bureau of Public Relations, American Dental Association, Chicago, Ill.

Harry B. Pinney, General Secretary, American Dental Association, Chicago, Ill.

H. B. Washburn, Trustee of the American Dental Association and chairman of the Contact Committee to the Council on Dental Therapeutics from the Board of Trustees, St. Paul, Minn.

J. Roy Doty, Associate Chemist, American Dental Association Bureau of Chemistry, Chicago, Ill.

The past year has been one of continued progress in the work of the Council. Donald A. Wallace, who first became affiliated with the Association about five years ago as Associate Chemist in the American Dental Assoriation Bureau of Chemistry, assumed the duties of Secretary of the Council, September 1, 1942. The Bureau of Chemistry, which cooperates closely with the Council, was fortunate to obtain the services of J. Roy Doty, who was formerly a member of the faculty of the State University of Louisiana.

Continued emphasis on the preservation of high standards for the composition and marketing of dental drugs and

cosmetics has characterized the Council's program during the past year. Selective Service statistics have served to emphasize the need of the American armed forces and civilian public for dental service of a continuing high quality. The Council members have given unselfishly of their time and energy during this period, to the country at large and to the profession through the Council. Frequently, problems arise that require more rapid action than would be necessary or even desirable in peace time. The Council has adapted its schedules to meet these exigencies.

The program of work for the Council meeting this year was especially heavy. The following is a brief discussion of each of the major topics covered.

THERAPEUTIC DEVICES AND PHYSICAL THERAPY APPARATUS

The Council has been authorized by the governing bodies of the Association to consider therapeutic devices and physical therapy apparatus. This group of products includes many devices, such as pulp testers, apparatus for electrosurgery, toothbrushes and apparatus for radiation therapy.

It is obvious that consideration of such a wide variety of products must be undertaken in methodical and step-wise fashion. It is anticipated that it will be necessary to add two new members to the Council in order to provide the scientific background necessary for evaluation of such items.

Tentative plans were discussed and it was decided that active consideration of articles of this class would be deferred for the present and that the profession and the trade would be notified when the Council began such consideration.

PRESENT STATUS OF INSTRUMENT DISINFECTION

Instrument disinfection is the subject of a great number of the inquiries received by the Council office from the profession. The Council's frequently reiterated stand has been that the methods of disinfection in order of effectiveness are: 1. Autoclaving. 2. Boiling in water. 3. Chemical disinfection. It was pointed out that the last method is not entirely dependable if the instruments are contaminated with sporulating micro-organisms. It was reiterated that a chemical disinfectant can disinfect only those areas with which it comes in contact. Thus, hinged or jointed instruments must be very carefully flushed with the disinfecting fluid in order that all nooks and crannies may be reached. The construction of some instruments is such that thorough disinfection by chemicals is difficult if not impossible.

Scientific investigation showing that instruments which are to be disinfected with gaseous formaldehyde should be free from water droplets was discussed. The solubility of formaldehyde in water is sufficiently great that a very small volume of water is capable of dissolving a much larger volume of gaseous formaldehyde.[1]

The possibility of disinfection of instruments by irradiation with ultraviolet light was again discussed. It was concluded that this method of disinfection is not practical at the present time.

DENTIFRICES

The supply of glycerin available to manufacturers of tooth paste has been sharply restricted in recent months. The increasing use of sugar by toothpaste manufacturers as a substitute for glycerin has been a matter of concern to the Council.

Glycerin, or some other material of similar water-retaining properties, is said to be necessary in the formulation of a stable toothpaste. Sugar-containing syr-

1. Nordgren, Gunnar: Investigations on Sterilization Efficacy of Gaseous Formaldehyde. *M. Lic. Acta Pathol. et microbiol. Scandinav.* Suppl. XL. Copenhagen: Einar Munksgaard, 1939.

ups of various compositions have been used as substitutes for glycerin. In the light of present knowledge, more appropriate substitutes would be propylene glycol or sorbitol, both of which have many physical properties in common with glycerin.

Scientific evidence of a conclusive nature is not yet available to enable the Council to decide whether the presence of sugar in toothpaste is likely to increase the rate or incidence of dental caries among those who use it daily. Studies now in progress may add significantly to knowledge of the subject.

As an expression of its current policy, the Council adopted the following resolution:

The Council does not view with favor the inclusion of the following four sugars in dentifrices: 1. Fructose (levulose). 2. Glucose (dextrose, corn syrup). 3. Maltose (malt syrup). 4. Sucrose (cane sugar, saccharose). These sugars are readily fermented by certain oral bacteria with the production of acids.

In the annual review of dentifrices for reacceptance, the Council will give particular consideration to the glycerin substitutes used in their manufacture.

LOCAL ANESTHETIC SOLUTIONS

The Council further implemented its stand in favor of simplification of the formulas of local anesthetic solutions intended for injection. The use of unduly complex vehicles or "bases" in addition to essential ingredients is regarded as obsolete practice.

The widespread use of local anesthetic solutions more potent than the accepted 2 per cent procaine hydrochloride solutions was thoroughly discussed. The consensus of opinion was that the general usefulness and desirability of such solutions has not been demonstrated and that, in the absence of adequate favorable evidence, such solutions appear to have very limited value in dentistry.

The results of a survey made by the Council of the methods employed by manufacturers of local anesthetic solutions to determine whether their products are sterile were discussed. It appears that the methods used by some of the manufacturers are not so satisfactory as the procedure described in the memorandum entitled "Memorandum of Details: An Elaboration of Section 36 of the Regulations Revised January 26, 1942" issued by the National Institute of Health. It was voted that the manufacturers of accepted local anesthetic solutions intended for injection be required to use the methods described in the National Institute of Health memorandum.

REVISION OF ACCEPTED DENTAL REMEDIES

A considerable portion of the time of the meeting was devoted to revision of the Council's book, Accepted Dental Remedies. It is planned that the ninth edition of this book shall be available for distribution during the summer of 1943.

The list of accepted products was revised and changes necessitated by the publication of the twelfth edition of the U.S.P. were made. It was decided that certain brands of products should be deleted from the accepted list for lack of adequate confirmation of earlier reports of their usefulness in dentistry. The arsenicals, bismuth sodium tartrate and the colloidal silver preparations were among those found to be in this category. The basis for deletion of the colloidal silver preparations was their weaker antiseptic value as compared with other available antiseptics. Since the current period of acceptance of some brands of certain preparations does not expire until 1944, all brands of such products will appear in the ninth edition of A.D.R. Continued listing beyond the ninth edition will be contingent upon presentation of new and adequate evidence.

The portions of the text which describe the deleted products will be revised and, to a large extent, retained, for the in-

formation of the readers of the book.

The Rules of the Council were modified in certain respects with a view to strengthening the program of the Council. It is suggested that manufacturers and distributors read the section of the ninth edition of Accepted Dental Remedies in which the rules are stated.

INFORMATIVE ARTICLES

During the interval between annual meetings, the following informative articles appeared in the Council's section of THE JOURNAL:

"Vinyl Ether (Vinethene)." Earl A. Zaus, B.S., M.D., Associate Professor of Physiology and Pharmacology, Northwestern University Dental School.

"Is Fluorine a Therapeutic Agent for Dental Caries?" Harold C. Hodge, Ph.D., Department of Biochemistry and Pharmacology, University of Rochester School of Medicine and Dentistry.

"Local Use of Sulfonamides." F. D. Ostrander, D.D.S., M.S., Assistant Professor of Dentistry, and F. W. Hartmann, M. S., University of Michigan School of Dentistry.

"Endocrines and Dentistry." Isaac Schour, D.D.S., Ph.D., D.Sc., Head of the Department of Histology, College of Dentistry, and Maury Massler, D.D.S., M.S., Director of the Child Research Clinic, College of Dentistry, and Lecturer in Stomatology, College of Medicine, University of Illinois.

The Council voted to invite several other qualified persons to prepare articles for publication in future issues of THE JOURNAL. It was also voted to acknowledge formally the services rendered during the past year by consultants of the Council by listing their names in Accepted Dental Remedies. The aid of qualified consultants is very important to the Council.

EXHIBITS AND MEETINGS

The exhibit of the Council and the Bureau of Chemistry was shown at the following constituent and component society meetings:

Chicago Midwinter Meeting, Chicago, Ill.

Missouri State Dental Association, St. Louis, Mo.

Wisconsin State Dental Society, Milwaukee, Wis.

Texas Dental Society, Fort Worth, Texas.

Harold L. Hansen, former Secretary of the Council, and Donald A. Wallace, Secretary of the Council, appeared before the following groups and societies, in addition to lay groups:

North Dakota State Dental Association, Jamestown, N. D. (Dr. Hansen).

Northwestern University Dental School, Chicago, Ill. (Dr. Wallace).

Chicago Section, International Association of Dental Research, Chicago, Ill. (Dr. Wallace).

APPRECIATION

The Council wishes to express its appreciation to those editors and other staff members of local and state dental journals who have cooperated with the Council in support of its policies with respect to advertising during the past year.

ACCEPTED DENTAL REMEDIES

The Council on Dental Therapeutics of the American Dental Association announces the inclusion of the following article in the list of Accepted Dental Remedies.

DENTIFRICES*

Swan Tooth Paste: Composition: See Comfort (Brand) Tooth Paste (A.D.R. Ed. 9, p. 100).

Manufactured by Comfort Manufacturing Company, Chicago, Ill.
Distributed by Allen Products, Chicago, Ill.

*A.D.R. Ed. 9, p. 96.

Admission of a product to the list of Accepted Dental Remedies does not imply a recommendation. It means that the product and the methods by which it was marketed at the time of consideration were not found to be in violation of the Council's published rules. Accepted products are reconsidered periodically. The files of the Council contain information on many drugs and dental cosmetics. All information is available upon request and inquiries are welcomed. A postal card will bring a prompt reply.

DONALD A. WALLACE, *Secretary.*

COMMITTEE ON LEGISLATION

DENTISTRY IN THE ARMED FORCES AND IN GOVERNMENTAL AGENCIES

IN civilian life, dentistry is considered an important factor in the welfare of the patient. During the last few years, there has developed a very close cooperation between the dentist and the physician for the benefit of the patient, and physicians who are unwilling to cooperate are in the minority.

In the armed forces and in the governmental agencies, there have remained a few physicians in important positions who have been unwilling to recognize the importance of dentistry as a health factor and who have persistently and energetically opposed all improvements in the Dental Corps. Because definite discrimination has persisted, there is developing a widespread sentiment among the dentists of the United States that something should be done. Editorials are appearing in all of the dental periodicals; and at all dental meetings, the situation is one of the topics of discussion. In Canada, where the dental service has been set up as a separate unit for Army, Navy and Public Health, the service is entirely separate from that of medicine. The Dental Corps has its own buildings and there is no influence whatever from the medical field. Those in charge of the dental service in Canada feel that they have accomplished much in this way and are very proud of their accomplishments, believing that they are giving a service that could not be duplicated under the old system. Officers of the Canadian Army dental service have appeared before dental groups in the United States and have explained their system in detail and have recommended it. There has been a disposition in England to recognize officers of the medical and dental field with far higher rank, and dentistry has its own direct approach from the dental unit to the commanding officer.

The Committee on Legislation has been receiving many communications from all over the United States for some time urging that some definite action be taken to secure more direct authority for the Dental Corps in the various services. It is apparent to all who have studied these matters that there is a definite need for direct approach from the different dental installations through the Dental Corps direct to the chief of the administrative office. There certainly should be a more direct approach for dentistry, with more authority for the Dental Corps in the handling of equipment and supplies and with regard to the promotion of its officers. Such an approach would mean saving of time and money and provide a more efficient Dental Corps.

Since the demand for a separate Dental Corps is growing very fast, one can foresee that immediately after the war there will crystallize a sentiment for legislation to this effect, and to free dentistry from medical domination. It is felt by many in the American Dental Association who have studied the problem that a complete separation of the Dental Corps from the Medical Corps would hinder the effectiveness of both corps, but the Committee on Legislation is definitely of the opinion that problems of control and efficiency in the Dental Corps could best be handled by dental officers.

There is also need for a more equitable plan of promotion of the officers of the Dental Corps, and this is especially true with regard to temporary appointments during the emergency. In some of the governmental departments, there is need for a permanent plan of promotion of its officers and the setting up of a separate dental division.

Under the act of March 3, 1911, a dental corps was established in the United States Army, and it was provided that there should be one dental officer for each one thousand enlisted men in the Army.

At the beginning of the first World War, although there was actually one dental officer for each 6½ medical officers, the Dental Corps did not have enough officers of sufficient rank and grade to enable it to maintain an efficient organization. In order to correct the situation, a law was enacted, October 6, 1917, providing that thereafter the Dental Corps of the Army should consist of commissioned officers of the same grade and rank as established by law for the medical corps, and that they should be distributed among such grades and in the same proportion as provided by law for the Medical Corps. This law gave the Army a highly competent Dental Corps.

January 29, 1938, a law was enacted which provided that there should be a certain number of officers in the Dental Corps and a certain number of officers in the Medical Corps; but this law was intended to apply to peace-time conditions; and since the present war has started, the peace-time ratio of dental officers to medical officers in the same rank and grade has not been maintained.

At the time of the enactment of the 1938 law, it was not the intention of Congress to handicap dentistry, and there is every reason to believe that it was the intention of Congress to maintain the proportional distribution that then existed; and especially is this true since Congress, in the same act, specifically provided that of the four assistants to the Surgeon General with the rank of brigadier general, one must be an officer in the Dental Corps; which indicates that it was the intent of Congress to provide dentistry with rank and grade equal to those of the Medical Corps.

Under the present set up, during this emergency, dentistry finds itself in the same position as before the enactment of the 1917 law; namely, it does not have enough officers of sufficient rank and grade, in comparison with the Medical Corps, to enable it to perform and operate at maximum efficiency.

There is great urgency for the more rapid promotion of dental officers who have been taken in as lieutenants. There should be a larger percentage of lieutenants made captains to establish a ratio similar to that of medicine. There is also reason to promote many of the captains to majors, and so on. Most of the discrepancies are in the lower ranks, and the greatest need at the present time is in those ranks. The President of the American Dental Association and the chairman of the Committee on Legislation have gone before the War Department and the Surgeon General a number of times in an endeavor to get some of these problems settled. Only after a number of visits to the Department did we

decide that only through legislation could we attain the desired ends.

For that reason, Congressman Sparkman of Alabama introduced H. R. 2442 and Senator Hill of Alabama introduced Senate Bill 1007: "To provide for the temporary promotion of officers of the Dental Corps of the Army of the United States." It is not possible by legislation to accomplish promotions all along the line, as the process becomes too complicated. All we could hope for in legislation was to bring about the promotion of top ranking officers, who would be in a position to fight the battles of dentistry and, after all, as authority flows from rank, these high ranking positions will give prestige to the Dental Corps and an opportunity to bring about some of these desired results. Also it must be remembered that there is no opportunity during a war to bring about changes in administration except minor changes within the department from a departmental ruling, as Congress is unwilling to make legislative changes in this regard. It is willing only to make temporary appointments during the time of the war, as permanent promotions are a matter of peace-time.

We have been told that the Department will make promotions in the Dental Corps at the present time only for reasons of responsibility, and that it does not adhere to the principle of a ratio of dentistry to medicine or a definite number of appointments. It states that it is willing to make these appointments where we can show a definite responsibility.

In the nine corps areas of the United States, there is a dental officer at each post who has the rank of colonel. The chief of the surgical service also has the rank of colonel, and apparently these carry equal responsibility or they would not have the same rank. When the colonel in surgery is transferred to the European theater of war, he is made a brigadier general and we contend that this should be the case with the colonel in the dental service. The same principle applies to the African theater of war and to the South Pacific. There is also need for an assistant in the dental department in the central office of the surgeon general as a consultant or inspector with the rank of brigadier general. The least that could be done for dentistry would be the appointment of four brigadier generals and a major general.

Prior to October 1942, dental standards for entrance into the Army were very high, but, after Pearl Harbor, the standards were lowered very materially, and many men whose mouths were in dire need of rehabilitation were taken into the army. In fact, out of the first million men who were inducted, there were 188,000 who were rejected because of dental defects, but later they were taken in and rehabilitated for the Army by the Dental Corps. This additional work was done by the Dental Corps, in addition to the usual amount of work of the corps.

Last year, the Army dental service replaced 29 per cent of the number of teeth extracted; in January of this year, 58 per cent; in February, 72 per cent; in March, 81 per cent. They extracted one-half million teeth in March. The teeth replaced in March numbered 458,000.

During the peak of the First World War, in 1917, there were 4,460 dental officers in the Army, and, during the peak six-month period, they made 4,000 dentures. At the present time, there are 12,000 dentists in the Army, and they are making 60,000 dentures a month and placing 1,500,000 fillings. Therefore, with a force which is less than three times as large as that during the previous war, they are making fifteen times as many dentures in one month as they made in six months during the other war; or ninety times as many dentures. This same proportion is also true of extractions, the care of facial injuries, fillings, etc. Certainly this shows a very

highly increased efficiency. By making these 60,000 dentures a month, the Dental Corps is, by denture work alone for the Army, making available for military duty 60,000 men who would otherwise be lost to the Army.

During the First World War, when the strength of the Army Dental Corps was 4,460, Congress saw fit to definitely establish a ratio of parity between the Army Dental Corps and the Army Medical Corps at 1 : 6½ and this pertained to numbers, rank, grades, etc. In the present war, there is a personnel in the Army Dental Corps of almost 12,000 at the present time, as against 39,000 in the Medical Corps, or a ratio of 1 : 3½; yet there has not been a disposition on the part of the War Department up to the present time to give the Dental Corps, in the matters of rank and grade, especially in the top ranks, even the ratio of 1 : 6½, which it had during the last war; and this in the face of the fact that although it is only three times as large as in the previous war, the Dental Corps is doing 90 times as much dental work as was done in that war. Notwithstanding the greatly increased efficiency and capacity of the present Dental Corps, there are now thirty-one brigadier generals in the Medical Corps and only one in the Dental Corps. This speaks for itself.

There is great reluctance on the part of the dental officers to make known their plight. This is understood by any one who has knowledge of the situation, as there is always the thought of conflict with superior officers and it is virtually impossible to get aid or information from this source. Attention is called to the practical example of Gen. "Billy" Mitchell "who spoke true, but out of turn."

For more than fifteen years, the American Dental Association endeavored to get a rear admiral for Dentistry in the Naval Dental Corps; and always this action was blocked. During recent legislation, the War Department opposed this legislation with a statement that it was against the best interests of the Department, and for reasons that it should be apparent to all were not well founded. In spite of the Department's attitude and opposition, the rank of rear admiral was established in the Dental Corps permanently and the bill carried provision for the appointment of temporary rear admirals in a relative proportion to that of medicine. In spite of the action of Congress and the signing of the bill by the President, there has been but one rear admiral appointed, and an appointment of rear admiral for dentistry has not been made for the central office of the surgeon general. This would appear to be a definite discrimination, and the least that the Department could do with any thought of equality and a relative ratio would be to appoint a rear admiral as inspector on the West Coast, a rear admiral as inspector on the East Coast, a rear admiral in the central area and a rear admiral in the central office of the Surgeon General. This would give four rear admirals, three temporary and one permanent, to the dental service at the present time as against nineteen rear admirals for medicine. The American Dental Association has been patiently waiting to see what the Department will do after the passage of this law, and its patience may finally become exhausted.

In order to secure the rank of brigadier general for the Army Dental Corps, it was necessary to get legislation in opposition to the Department's attitude and over the protest of the Department. However, this legislation was enacted and it has proved a very valuable means of promoting the efficiency of the Dental Corps. The Department has seen the wisdom of this legislation. The law enacted was for their benefit, for the benefit of the Medical and the Dental Corps and for the benefit of the entire Army personnel. The Medical Corps of the Army states that it is now opposed to legislation for dental purposes.

The Surgeon General of the Army is responsible for the proper functioning of the Medical as well as the Dental Corps, and he should be favorable to any plan that would make for the greater efficiency of the Dental Corps, as this would reflect credit upon his office and be to the advantage of both the Medical and the Dental Corps.

In 1917, when the draft act was passed, the status of dentists and dental students was not definitely outlined, in consequence of which there was a widespread drafting of a large number of dentists and dental students between the ages of 21 to 31 into the military services as enlisted men. The report of the Surgeon General for 1917-1918 shows that in the AEF alone, there was a total of 2,000 dentists and dental students as enlisted men, with 1,876 commissioned officers. These 2,000 enlisted men were never commissioned, since the Dental Corps was closed for commissioning, September 18, 1917, and did not open until October 3, 1918, and was again closed November 9, 1918.

Under the present Selective Service Act of 1940, through rulings, interpretations and memoranda, there have been only a few more than 200 dentists taken into the services as enlisted men and, of this number, 190 have been commissioned to date. In addition, the dental students of all the dental schools and those men who have signified their intention to study dentistry have been commissioned (if they passed the physical examination) in the Navy as ensigns, or in the Army in the medical administrative corps; which means that they will be permitted to continue their dental education before being taken into the armed forces as commissioned officers.

The legislative committee of the American Dental Association is not fostering legislation for any reason other than that apparently we are unable to get the deserved increased ranks, without actual legislation. We are eager to see a spirit of cooperation between the Medical and the Dental Corps, and medicine has every reason to foster this spirit. They need our support and cooperation as much as we need theirs.

The Public Health Service has in Congress bills to reorganize its service. Dentistry was forgotten in these bills, and the Department was only willing to grant a grade as high as captain, which kept Dentistry in a very inferior position as related to that of Medicine. It was only through our efforts in the Senate that we were able to put into this bill any provision for Dentistry. The bill finally passed the Senate with a provision for an assistant surgeon general, who will be a brigadier general and attached to the Surgeon General's office, with provision for a direct approach for Dentistry. This bill is now pending in the House and there is good reason to believe that this provision will remain in.

There is legislation pending for the Veterans Service and Dentistry is again left high and dry and in a position very inferior to that of Medicine.

It will be observed that this is not a fight on the part of Dentistry in one department, but that all services are faced with the same problems.

STERLING V. MEAD, *Chairman*,
Committee on Legislation.

COMMITTEE ON ECONOMICS

HEALTH INSURANCE UNDER SOCIAL SECURITY: A NEW BILL PRESENTED BY SENATOR WAGNER

WITH the Beveridge report still a lively topic of conversation at the conference table and on the smoking car of the suburban train, and with the report of our own National Resources Planning Board just off the press, the American public is very much on the alert for new developments in the field of social planning. Since plans for supplying medical care are always high on the list of basic human needs that are the concern of the social planners, the dental profession must be particularly vigilant. Consequently, a bill designed to greatly expand the scope of social security which was introduced in the Senate June 3 by Senator Wagner is of particular interest to the profession.

Advocates of the social security principle even before the passage of the present act were very critical of the bill because they felt that it was not of a broad enough scope. The National Resources Planning Board, in its report, recommends a comprehensive program for social security that goes far beyond our present system. The President has insisted that although further expansion of the social security program might be curtailed by the war effort, planning toward social security should not be diminished. There are many who believe that social security will be one of the major campaign issues in the coming national election. Interestingly enough, it seems that party lines are not likely to be drawn as for or against social security. Rather, the major parties will vie with one another for a bigger and better social program. It is frequently suggested that the American public is so imbued with the desire for the "four freedoms" of the Atlantic Charter, i.e. freedom of speech and expression, freedom to worship, freedom from want and freedom from fear, that they will not tolerate a national program that jeopardizes any one of these principles. Freedom from want spells for many "social security."

Against this background of social agitation, the new Wagner bill to extend the provisions of the Social Security Act to cover many of the uncertainties of life not now taken into consideration becomes of considerable significance. The significance of the bill lies not in the likelihood that it will be passed (with the present heavy tax burden, its passage would hardly seem likely), but in that it is an indication of the probable pattern of future legislation and gives formal notice of demands which, it may be expected, will be repeated with even greater force. Significance is added to the bill in that it has the support of both of the powerful national labor organizations. This gives a clear indication as to the position Labor may be expected to take with regard to future legislation in this field.

The Wagner bill would both reorganize the existing services of the Social Security Agency and greatly extend the benefits that are now provided for by the act. The bill, S. 1161, creates a unified national social insurance system, consisting of public employment offices, old-age and survivors' insurance; permanent disability insurance and lump-sum death benefits; protection of the social security rights of men and women in the armed forces; unemployment insurance; temporary disability insurance and maternity benefits; unemployment allowances upon termination of military service, and medical and hospitalization insurance.

For all of these insurance benefits, the wage earner will pay 6 per cent of his

net income. This sum will be matched by the employer.

While dentists, as citizens, will be interested in all provisions of this bill, especially the extension of the old-age and survivors' insurance to cover the professions, the interest of the profession will be centered largely in the medical services that it would establish. The bill provides for the immediate establishment of medical services both of the general practitioner and of the medical specialist. It also provides for hospital and laboratory services. Provisions for dental services, nursing and other needed benefits would be added at a later date, according to the bill.

The medical and hospitalization benefits would be under the supervision of a national advisory medical and hospital council. The Surgeon General of the United States Public Health Service would act as chairman and would appoint sixteen members to the council from panels of names submitted by professional organizations, as well as from other agencies concerned with medical or hospital services and with medical education.

This council would advise the Surgeon General with regard to professional standards of quality, designation and control of medical specialties, standards for hospitals, methods of paying for services and the establishment of advisory boards necessary to carry out the program. They would also advise on setting up studies to evaluate the program; on the establishment of methods and arrangements to coordinate various aspects of medical service to improve standards of care, and on the provision of grants-in-aid for professional education and research.

The introduction of any scheme of compulsory health insurance will affect profoundly the destiny of the dental profession. Should a supreme council such as that proposed by Wagner be set up to administer a health program, it will be of paramount importance that the dental profession be represented. While it seems hardly conceivable that a medical council of this nature should be set up without the dental professions being asked to participate, experience has shown that, in spite of its important rôle in the health field, dentistry is frequently overlooked when matters of public health are being considered.

Under the medical and hospital plan, benefits would be available to all wage earners and their dependents on whom a social security tax is paid under Title IX of the Social Security Act.

The bill would provide for all medical, special medical, laboratory and hospital benefits. Medical care may be supplied by any physician legally qualified by the state who has agreed to work under the terms of the program. Individuals receiving benefits are to be permitted free choice of a general practitioner from a published list of participating physicians, subject, of course, to the consent of the practitioner. The Surgeon General, with the assistance of the council and with due regard to standards and certifications developed by competent professional agencies, will designate services to be provided by specialists. With the same guidance, he will select those physicians who are qualified as specialists. The services of a specialist would be available upon the advice of a general practitioner.

While the details of administration are not set forth in the bill, the guiding principles to be followed in setting up the administration are provided for. Prompt and efficient care is to be assured, and a personal relationship between physician and patient is to be promoted. Financial incentives sufficient to encourage a high standard of service are to be provided the professions, and opportunities for postgraduate study are to be made available. The program is to be conducted with a view to preventing disease and disability rather than to providing curative services only.

Payment for service may be handled

in any one of a number of ways, depending on the desires of a majority of the general practitioners in an area. (Incidentally, the bill does not define an "area.") Methods of payment suggested in the bill include a fee for service according to a schedule approved by the Surgeon General, on a per capita basis, a salary basis, whole or part time, or a combination or modification of all.

A careful reading of this section of the bill suggests that considerable effort has been expended to render the medical program acceptable to the profession through placing a large measure of control over its operation in the hands of the profession. This would suggest that the professions have won at least a part of their fight against a thorough-going bureaucratic control of medical service.

The Surgeon General may prescribe the maximum number of beneficiaries for whom a general practitioner may undertake to provide medical services. He is also authorized to establish sufficient hearing bodies to deal with complaints, either from the beneficiaries or from the profession. Complaints involving matters of professional practice or conduct must be heard by a body containing professional representation. If the complaint has to do wholly with such professional matters, the hearing body must be composed entirely of professional persons.

If it is found necessary, the Surgeon General may require that individuals requesting medical service pay an initial fee or a fee for each service rendered in order to avoid abuse of the service.

Hospital services are to be limited to thirty days per year. Should funds be found sufficient, benefits may be increased to a maximum of ninety days a year. Contracts are to be negotiated periodically by the Surgeon General with the hospitals and the rates to be paid shall be not less than $3 nor more than $6 a day.

With regard to dentistry, the bill has the following to say:

The Surgeon General and the Social Security Board jointly shall have the duty of studying and making recommendations as to the most effective methods of providing dental, nursing, and other needed benefits not already provided under this title, and as to expected costs for such needed benefits and the desirable division of the costs between (1) the financial resources of the social-insurance system and (2) payments to be required of beneficiaries receiving such benefits, and shall make reports with recommendations as to legislation on such benefits not later than two years after the effective date of this title.

In view of the complexity of the financial aspects of the dental problem and the many gaps yet remaining in our knowledge of the problem, the granting of this period for study before including dentistry in the benefits of the bill would indeed seem wise. It would give the dental profession time to plan and present for consideration a sound, well-balanced program in which the welfare of both the public and the profession could be amply protected.

The statement in the bill regarding dentistry indicates clearly that dental services are excluded for the time being from the original provision for medical care because of economic problems.

One of the questions that must be answered before a sound dental program can be developed is: the extent of existing need for dental care among various sections of the population, with such factors as geographic area, economic class, age and sex controlled.

The rate of development of new dental defects among various groups must be determined. The extent of the present demand for dental service must be determined and estimates made of the demand for such services under an insurance program. The extent of services now being offered and facilities available through private and public clinics and industrial and school dental programs must be known. Consideration must be given to the amount of care now being received by various sections of the population under the present organization of practice.

Information on dental needs having been obtained, estimates must be made of costs of services. Estimates on cost must include the cost of meeting the initial need for care under various plans for more or less complete care; the cost of providing maintenance care for persons whose initial needs have been met, and the cost of providing service by various means, such as the dental trailer, to those sections of the population residing in remote areas. Determination must be made as to the cost of operating a dental program under varying conditions, in private offices, in clinics, in communities of varying size and in various sections of the country. The number of dentists required to operate the program, as well as the income that dentists should expect to receive, is also a question requiring an answer.

The bill directs the Surgeon General and the Social Security Board to study these economic problems jointly and to make recommendations relative to the inclusion of dental service in the health program. With these agencies of government assigned to study the dental program, it appears imperative that the dental profession be equally informed, in order that they may exert their full weight when issues of such importance to the dental health of the public and to the welfare of the profession are being decided. Unless the dental profession is prepared, the answers to these questions will be determined by outside agencies who may not be thoroughly familiar with the problems peculiar to dentistry. Experience has shown that when such plans are being drawn, if accurate information is not available, figures frequently are snatched from the air without regard to accuracy and selected with a view to favoring a predetermined policy.

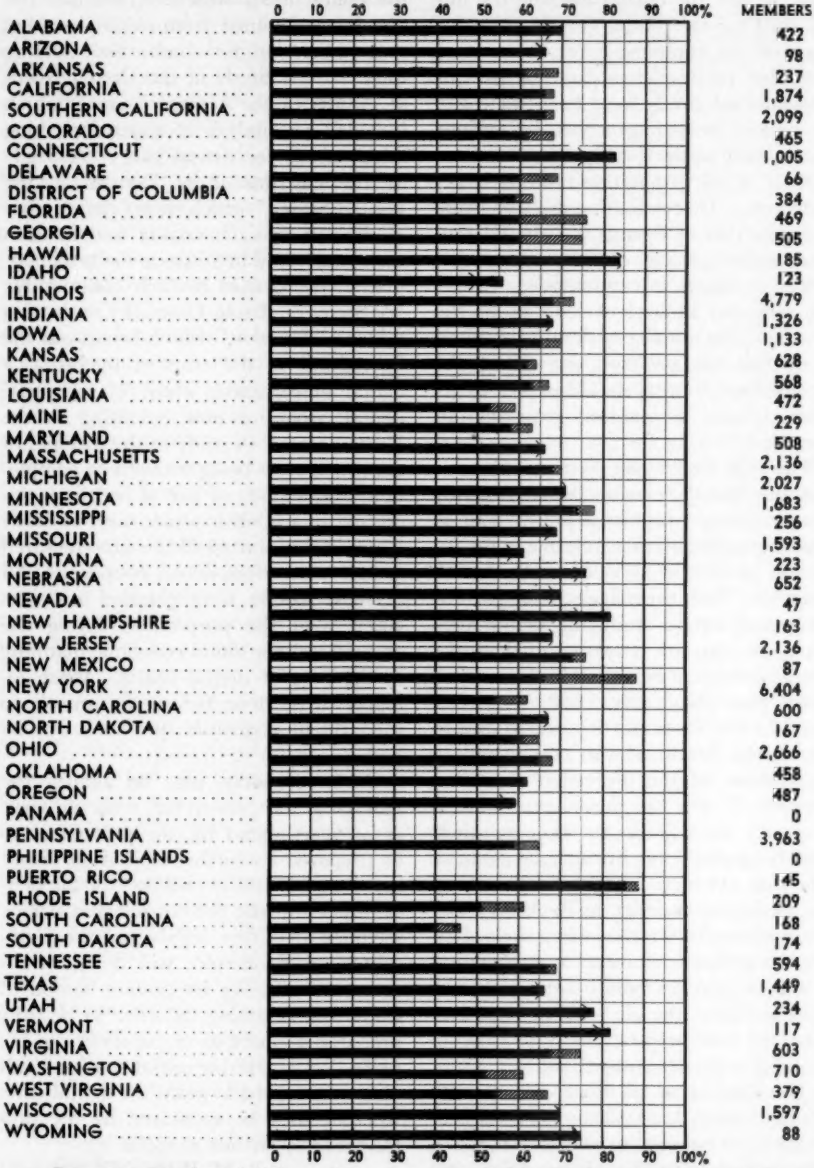
The Committee on Economics has for a long time anticipated the need for economic data essential to planning for such dental programs. The efforts of the committee have been focused on gathering and correlating such data. Much information has been gathered from the research of other agencies interested in the dental field. Much information has also been obtained from original studies undertaken by the committee. Among these are "A Study of the Dental Needs of Adults in the United States," which included an analysis of costs of meeting initial needs for dental care; "A Study of the Distribution of Dentists in the United States," which shows the number of dentists in each county and in each community and in addition the total population per dentist in each community; "A Study of Rising Costs of Conducting a Dental Practice," which brings out the fluctuation in the costs of operating a dental office, and a study of industrial dental programs now operating in the United States. A study of the incomes of dentists is now being brought to completion, and a study of dental programs operating in schools is under way. A study is now being started of the time required to perform various dental operations. All of these studies were planned and executed with the purpose of laying the groundwork for sound economic planning in the field of dental health. Much remains to be done before the answer to the critical economic questions can be had.

While the odds may be against the passage of this present bill, it should serve as an alert signal for the professions to be prepared for further legislation. Since the two year "study proviso" for the dental aspects of the present bill may not be included in future legislation, the Committee on Economics will do all in its power to step up its present tempo of study and planning in order to be fully prepared to meet its responsibility to the profession in offering sound economic advice with regard to plans for dental care, whether they be sponsored by the profession or by outside agencies.

R. M. WALLS, *Chairman*
M. L. DOLLAR, *Secretary*

Membership Page

PERCENTAGE OF DUES RECEIVED IN CENTRAL OFFICE AS OF JUNE 30, 1943, AS COMPARED TO 1942 MEMBERSHIP



Percentage based on dental population figures supplied by the State Society Secretaries.

1943 percentage 1942 percentage

NEWS ITEMS

DENTAL HYGIENISTS NEEDED FOR ARMY DISPENSARIES

To supply the Army with needed dental hygienists, the U. S. Civil Service Commission has eliminated the experience requirement for such personnel. Many hygienists are in demand for Army hospitals and dispensaries throughout the country, particularly in the West and Southwest.

Dental hygienists are under federal civil service regulations and are stationed only within the United States. They receive $1,970 a year entrance salary, including overtime pay. The work week of forty-eight hours includes eight hours of overtime.

Experience is no longer required for dental hygienist positions. Completion of a course in a recognized school of oral hygiene and registration as dental or oral hygienist is all that is necessary to qualify for the positions. There are no age limits and no written tests. Standard application forms must be filed with the United States Civil Service Commission, Washington, D. C.

Persons studying oral hygiene may also file, receive provisional appointments and enter on duty after completion of their courses and registration.

Persons who are willing to work in any part of the country have the greatest chance of receiving appointments within a short time. Applicants who desire information about living conditions, etc., in areas where Army hospitals and dispensaries are located should, upon receiving an offer of appointment, contact the appointing officer for such information. It is possible that vacancies will occur in the Public Health Service and the Veterans' Administration.

Persons already being utilized to their fullest capacity in war work should not apply. Federal appointments are made in accordance with War Manpower Commission policies and employment stabilization plans. Persons selected for appointment may be required to secure statements of availability, but these need not be secured until an offer of appointment is received.

Full information and application forms may be obtained at first-class and second-class post offices, at Civil Service regional offices and at the U. S. Civil Service Commission in Washington, D. C.

AMERICAN SOCIETY OF DENTISTRY FOR CHILDREN

THE Massachusetts unit of the American Society of Dentistry for Children, formed April 17, 1941, has for its purpose the promotion and development of dentistry for children in the United States; also, the creation of such enthusiasm as will, by its example, serve to awaken a spirit of emulation and cooperation in other countries throughout the world.

In 1942, the Massachusetts unit voted to have monthly meetings in place of one annual meeting in order to allow for more frequent discussion of current problems. The organization agreed to have these meetings in the form of a luncheon each month. The response has been gratifying with respect to both numbers and enthusiasm.

Group participation was assured by

beginning each meeting with a question and answer period. These quizzes brought out many interesting ideas and subjects for discussion.

In the past year, the organization has helped the Massachusetts Department of Public Health to sponsor a refresher course in children's dentistry. Standards for judging dental clinics set up and approved by the unit will assist the Massachusetts Department of Public Health dentists in their new responsibility of licensing dental clinics in Massachusetts in the coming year.

CATHERINE F. RONAN, D.M.D.,
BAILEY P. CHADBOURNE, D.M.D.,
HAROLD BERK, D.M.D.
Boston, Mass.

FIELD TRAINING IN HEALTH EDUCATION AT CLEVELAND HEALTH MUSEUM

FROM August 9 to September 4, twenty-seven students in health education from the University of North Carolina will work as Museum interns to receive a course of instruction, do laboratory work and gain field experience in methods of health education, especially in handling health exhibits. Among those students are the seventeen who were awarded fellowships by the United States Public Health Service, from a grant made available by the W. K. Kellogg Foundation.

The four-week course at Cleveland Health Museum is part of a three-months' supervised field experience required in addition to nine months' academic training in order to obtain a master of science degree in public health. The postgraduate students come from sixteen states: Arizona, California, Colorado, Illinois, Indiana, Missouri, Nebraska, New Hampshire, New York, North California, Ohio, Pennsylvania, South Carolina, Tennessee, Washington, Wyoming. One student comes from Lima, Peru.

Many of the students have been engaged in health work, as directors of school cafeterias, teachers of physical education or home economics in colleges, assistant directors of state hospitals, nutritionists, etc.

The course will be conducted by Bruno Gebhard, M.D., who is director of the Cleveland Health Museum and an associate in health education, Western Reserve University, School of Medicine.

Besides instruction in the principles and methods of visual health education, the students will gain practical experience in three work units. The first one deals with ideas, facts, figures and manuscripts. Another unit is centered around designing, constructing and budgeting of exhibits. The third work unit will handle placement, publicity, visitors' reaction and follow up.

The Museum's facilities, including the workshops, the loan service, traveling exhibits, film library and, of course, the Museum's own exhibits, will be used for this training.

OBITUARY

FREDERICK WESLEY HINDS, D.D.S.

(1888-1943)

FREDERICK WESLEY HINDS, aged 55, dean of Baylor University College of Dentistry, Dallas, Texas, died Friday, June 4, after a several months' illness. He had been dean of the college for fifteen years. In March of this year, he

FREDERICK W. HINDS, D.D.S.

was elected president of the American Association of Dental Schools.

Dr. Hinds was born in 1888, in Hubbard, Minn. He was educated at St. Cloud's Teachers' College and the University of Minnesota, where he received the D.D.S. degree in 1915. He practiced in Park Rapids, Minn., from 1916 to 1926, and then moved to Dallas, Texas, to become an instructor in Baylor University College of Dentistry. He was made superintendent in 1927 and has been dean since the latter part of that year. He has practiced dentistry in Dallas since 1928.

Dr. Hinds married Sara Marie Holm, of Stillwater, Minn., January 15, 1916, and they resided for a time in Park Rapids, Minn., where their two children were born. Dr. Hinds served as a mayor of Park Rapids from 1923 to 1925.

Among the organizations in which Dr. Hinds held membership were the American College of Dentists, the American Association for the Advancement of Science, the American Association of Dental Schools (executive committee), the American, Texas and Dallas County dental associations, Xi Psi Phi dental fraternity and Omicron Kappa Upsilon (dental honorary fraternity). He was a York Rite Mason and a Shriner, a member of the Lakewood Country Club, the Dallas Athletic Club and the Dallas Rotary Club, and a communicant of the Episcopal Church.

Dr. Hinds had contributed to various dental journals and had lectured and presented clinics in the United States and Canada since 1919.

He is survived by his wife; a daughter, Charlotte; a son, Edward, a dentist; his mother, Mrs. E. R. Hinds, and a brother, Temple Hinds, of Hubbard, Minn.

QUESTIONS AND ANSWERS

The answers here published have been prepared by authorities, but do not represent the opinion of the American Dental Association as an organization or of any other official bodies unless specifically stated in the reply.

To the Editor: What suggestion can you make regarding this case? An aviator, aged 30, sought consultation, six months ago, regarding a pain in the lower left third molar area. Roentgenograms revealed a horizontally impacted third molar. Clinical examination disclosed infection of the tonsils. The tonsils were removed and, one week later, the patient complained of loss of taste. The sense of taste returned for a few days, then disappeared again and a metallic taste developed. The lower left third molar was then extracted. The postoperative course was uneventful and the taste sensation returned, continuing for about a week. The metallic taste reappeared and has persisted for six weeks. Although the patient's mouth appears to be healthy, I have treated it for two weeks with applications of chromic acid and hydrogen peroxide. The taste persists.

Captain DC

ANSWER

When the sense of taste appears and disappears for no apparent reason, the case may have a neurologic basis and the patient should be examined by a neurologist. It is true that a perverted sense of taste (parageusia, paresthesia) may follow injury or severing of the gustatory nerve fibers, but it would be rare to have it follow tonsillectomy. From the facts given, it is not possible to make a diagnosis. It appears that the metallic taste is not caused by any local dental condition, but painstaking removal of all sources of local irritation and careful oral prophylaxis should be carried out on general principles.

M. K. H.

To the Editor: I have a patient who has one of those baffling cases of bleeding gums with no apparent infection. I have suggested the use of vitamin C to her, but she is disregarding her case at present.

She gives the following history which may be significant. Her aunt developed a condition diagnosed as "osteoporosis" of the left leg by a bone specialist, and bleeding of the gums at the age of 40. This patient at the age of 35 developed "osteoporosis" in the right leg and bleeding of the gums.

Any suggestion will be appreciated.

D.D.S., Illinois.

ANSWER

Bleeding of the gums usually results from irritation of the gingivae such as is caused by deposition of dental calculus, poor dental work, food impaction and toothbrush trauma. Careful local treatment to eliminate these sources of irritation and improve oral hygiene will control most cases. However, occasionally bleeding will persist in spite of thorough local treatment. It is then best to consider the bleeding as a symptom of some general disturbance, and the case should be studied by a competent physician. Vitamin C deficiency, diabetes mellitus, one of the blood dyscrasias and endocrine dysfunction must be considered. Any systemic disturbance must be treated in order to improve the general health. In the case described above, the cause of the osteoporosis (if actually present) should be determined if possible and treated. Although there is probably no connection between the loss of calcium from the long bones and the bleeding, the cause of the osteoporosis may lower the oral tissue resistance and bleeding of the gums may result.

M. K. H.

CURRENT LITERATURE

Effect of Bone Dysplasia (Overgrowth) on Cranial Nerves in Vitamin A Deficient Animals

By Edward Mellanby

Deficiency in vitamin A causes degenerative changes in the fifth nerve and gasserian ganglion. There is often an association between degeneration of fibers of the first division and xerophthalmia, degeneration of the fibers supplying the teeth and gums and hyperplasia of the gingival epithelium. Sensory fibers of the fifth nerve are destroyed. Bone changes at the base of the skull near the nerve, due to A avitaminosis, are sufficient to account for this degeneration. Overgrowth of the petrous portion of the temporal bone seems to cause pressure on the ganglion fibers to the pons. These central branches are bent and stretched. Chromolysis and degeneration noted in the ganglion cells may be due to mechanical pressure from the abnormal bone. There is no evidence of pressure on peripheral portions of the fifth nerve, even though the foramina rotundum and ovale are narrowed and thickened and the sphenoidal fissure is thinner. The effect on the fifth nerve is probably due to pressure directly on the ganglion.—*J. Physiol.*, **100**:408, May 1943.

David B. Scott.

Treatment of Preoperative and Postoperative Pain in Exodontia

By V. H. Ewan

The types of pain observed most frequently in exodontia are hysterical, neurasthenic, organic and postoperative. Correct diagnosis is imperative for proper treatment. Etiologic factors in postoperative pain are anesthetic, traumatic and septic. In cases of poor general resistance and inadequate diet, the dentist should not assume full blame for postoperative pain. Complications are prevented by leaving clean, smooth wounds and by judicious curettage. Local application of sedatives and sulfathiazole and socket dressings are helpful. For internal medication, the ordinary anodynes may be prescribed and, in severe neuralgia, codeine-containing drugs may be used.—*Illinois D. J.*, **12**:198, May 1943.

S. J. Fanale.

Toothache and the Aviator

By T. V. Joseph et al.

Of the men exposed to simulated altitude runs in low-pressure chambers, 1.2 per cent experienced toothache. The pain was due to (1) reaction of vital pulps of carious teeth to lowered atmospheric pressure; (2) reaction of degenerated pulps to lowered pressure, (3) the presence of inlays with residual air spaces beneath them. Expansion of the air trapped beneath the inlay may cause pain or expulsion of the filling. The histologic structures allow little compensation for changes in circulatory or gaseous volume within the confined area of the pulp chamber, root canal or apical alveolar structure; therefore, pathologic conditions become apparent in the low-pressure chamber. —*U. S. Nav. M. Bull.*, **41**:643, May 1943.

S. J. Fanale.

Temporomandibular Joint

By L. L. Willis

Abnormal articulation of the temporomandibular joint may cause erosion of the tympanic plate by the condyle, and mandibular subluxation, with possible perforation into the external auditory canal; steepening of the posterior surface of the articular eminence or flattening of the condyle by aseptic necrosis, or deep erosion of the entire glenoid fossa, producing an increase in joint space together with increased lateral movement.—*U. S. Nav. M. Bull.*, **41**:681, March 1943.

S. J. Fanale.

Demerol-HCl: A New Drug in the Practice of Surgery

By M. L. Weinstein

Demerol-HCl was found to be an ideal preanesthetic medicament. It is valuable in mouth and thoracic surgery when anal-

gesia and control of salivation are desired. It may be used in place of morphine and atropine. The average adult dose is 100 mg., its effect occurring fifteen minutes after injection. Oral administration of two 50 mg. tablets produces analgesia within twenty to sixty minutes. The drug does not depress the respiratory and circulatory systems and has no effect on the hematopoietic system. It has all the advantages of morphine and few of its disadvantages and can be used as a substitute in most cases.—*Am. J. Surg.*, **60**: 267, February 1943.

S. J. FANALE.

Wire Suturing in the Treatment of Facial Fractures

By STUART D. GORDON

STAINLESS steel suture has proved valuable in the treatment of fractures of the facial bones. In the reduction of seven malar, two maxillary and fifteen (one condyle) mandibular fractures, only three infections occurred. Two were in soft tissue only, and in the third, a case of angle fracture of the mandible, osteomyelitis developed. The wires remained in place in spite of the soft tissue infection. In two cases, wires were inserted through an incision in the oral mucous membrane without complication. Wire sutures allow accurate reduction and local fixation and, in mandibular fractures, control fragments that otherwise would be difficult to manage.—*Canad. M. A. J.*, 48:406, May 1943.

PETER P. DALE.

Unusual Tumor of the Tongue

By P. D. BRADDON

A GIRL, aged 14, appeared at the Radium Clinic, Royal Prince Alfred Hospital, with a rapidly growing tumor of the tongue, first noted five weeks earlier. The main symptoms were caused by its rapidly increasing bulk. The tumor measured 2.5 by 1.5 cm., and grew from the center of the anterior two-thirds of the dorsum of the tongue. The mass was fairly hard, homogeneous and pedunculated, the base measuring 1 cm. in diameter. Ten days elapsed before treatment could be instituted, the tumor increasing 60 per cent in bulk and breaking down at the apex. Pathologic examination, after successful surgical removal and a permanent gold seed radon implant of 6000 r dosage, revealed that the growth was an angio-endothelioma of great cellular activity.—*M. J. Australia*, 1:253, March 20, 1943.

PETER P. DALE.

Alteration of Occlusal Relations Induced by Experimental Procedure

By CARL BREITNER

A COMPLETE and lasting change in occlusal relations was created in an adult monkey without application of mechanical force, by paralyzing the muscles of mastication. The balance between muscular force and skeletal resistance was disturbed and an Angle Class III malocclusion was produced in seventy-two days. This condition persisted long after recovery of the affected muscles. By bite raising and opening, a Class II and a Class III malocclusion were also produced. The results support the theory that disharmony among the muscular forces or between muscular forces and the bony architecture is a possible cause of malocclusion. This suggests that physiologic modifications may be employed in orthodontics without the use of conventional mechanical devices.—*Am. J. Orthodontics*, 29:277, May 1943.

E. GUNNAR JOHANSSON.

Control of Hemorrhage

By W. F. HULSE

INJECTION of 2-5 cc. of sterile oxalic acid solution (1 gm. oxalic acid in 1 liter distilled water intravenously is attended by a rapid and rather sustained fall in blood coagulation time. The total oxalic acid level in the blood is raised far above that which could be accounted for by the small amount administered. This phenomenon has not been explained. No toxic manifestations have been noted. Prothrombin production appears to be promoted; blood viscosity is increased, and there is a antagonistic action to heparin and hirudin. Contraindications are essential hypertension, peripheral vascular disease, thromboangitis obliterans and allied conditions. Clinically, the solution is advantageous in controlling inaccessible hemorrhage. It is best used in moderate hemorrhage, but, in larger amounts, may be effective against massive bleeding. Carotid artery and other deep hemorrhages have been arrested. The oxalic acid solution may be administered to both donor and recipient

in cases of transfusion.—*Arch. Otolaryn.*, 32: 831, June 1943.

DAVID B. SCOTT.

Endemic Fluorosis in Great Britain

By LEO SPIRA

SEVERAL new sources of toxic amounts of fluorine in drinking water have been found which seem to help to account for the increase in fluorosis in areas where soil and prefiltration water show a non-toxic fluorine content. Tests show that fluorine is absorbed from (1) the filter powder used in metal-filter water purification, (2) ingredients used in building concrete wells for storage of drinking water (clay, chalk, lime, cement), (3) certain iron pipes and iron storage tanks and (4) certain aluminum cooking utensils.—*Edinburgh M. J.*, 50:237, May 1943.

DAVID B. SCOTT.

Influence of Avulsion of the Trigeminal Nerve on the Human Nose

By F. L. LEDERER and R. DINHOLT

TEN clinical cases were studied wherein section of the sensory roots of the trigeminal nerve had been performed from five months to thirty-nine years before examination. Nine cases showed anesthesia of the affected side, one hyperesthesia. There were no major pathologic changes, and very little histologic difference between the two sides of the nose. Neither vessels nor glands showed changes attributable to loss of the fifth nerve fibers, nor was there a change in nasal secretion, ulceration or crust formation. There is a possibility that the terminal nerve, as a part of the autonomic system, exerts greater influence than is generally thought. It is established that sensory fifth nerve denervation is not followed by either temporary or permanent damage to the nasal mucosa. It does not predispose to pathologic conditions of the nose.—*Arch. Otolaryn.*, 37:768, June 1943.

DAVID B. SCOTT.

Effect of Manganese and Boron Compounds on the Rat Incisor

By G. D. WESSINGER and P. J. WEINMAN

THE experiments represent part of a study intended to search for elements ingestion of which can cause enamel hypoplasia. Administration of manganese chloride subcutaneously to white rats in dosages greater than 180 mg. per kilogram caused enamel hypoplasia. Amelogenesis was interrupted in the apical fourth of the zone of matrix formation. This is in contrast to production of hypoplasia by strontium ingestion, which extends over the whole formative zone. Subcutaneous injections of borax and/or boric acid with a total borax content of less than 200 mg. per kilogram did not cause enamel hypoplasia. Apparently, the susceptibility of the ameloblasts to various agents varies at different ages of the cells.—*Am. J. Physiol.*, 139:233, June 1943.

DAVID B. SCOTT.

Volume Flow of Resting Salivary Secretion

By C. R. SPEALMAN

RESTING saliva was collected from the mouths of fifty-eight students under controlled conditions. Each subject maintained his head in horizontal position and allowed saliva to flow for five minutes into a beaker which was placed tightly against the lips, under the opened mouth. Calculations were made for standard deviation, per cent deviation and standard error of the mean. Results show that the mean of a sufficient number of determinations represents a value which is reproducible and characteristic of the individual. The distribution of the mean of two values of a limited number of subjects is skewed. The modal value is about 0.24 cc. per minute. The lowest mean of two values obtained was 0.08 cc. per minute, the highest 0.88 cc. per minute.—*Am. J. Physiol.*, 139:225, June 1943.

DAVID B. SCOTT.

Deficiency Stomatitis

By H. R. SANDSTEAD

NUTRITION studies in New York City and Hagerstown, Md., revealed that 40 and 33.8 per cent, respectively, of the mouths examined had lesions on the buccal surface of the cheek. The stomatitis was classified as mild, moderate or severe. All degrees were asymptomatic and bilateral. Lesions were differentiated from those of lichen planus, leukoplakia, thrush, mucosal atrophy and pellagra. Laboratory findings seemed to rule out mycosis, and biopsy revealed no significant histologic changes. Therapy consisted of experimental dietary supplements of nico-

tinic acid, ascorbic acid, thiamine hydrochloride and riboflavin, fed to different groups of patients. Riboflavin proved efficacious, especially in the Hagerstown group, and it is suggested that the stomatitis may be a manifestation of ariboflavinosis.—*U. S. Pub. Health Rep.*, Supp. 169, 1943.

M. J. SHEEHY.

The Effect of Fluorine on Dental Caries

By D. B. AST

A COMPLETE résumé is given of all former work to date regarding fluorine as related to dental caries. Theories about its action, and the importance of its presence in drinking water are described. It is proposed to test the accuracy of the caries-fluorine hypothesis by deliberately placing non-toxic doses (14.7 pounds of sodium fluoride per million gallons of water) in the public drinking water of one community, and using a comparable community with fluorine-free water as a control. The study would extend over a period of from ten to twelve years.—*U. S. Pub. Health Rep.*, 58:23, June 4, 1943.

M. J. SHEEHY.

Moulages as an Aid to Maxillofacial Restorations

By J. B. BARRON

FACIAL reproductions are used in maxillofacial surgery for working models for surgical prosthesis or as records of preoperative and postoperative results. They are also employed in planning the direction of an incision, affording a three-dimensional view of the structures to be worked on. The hydrocolloids and paraffin are used to obtain the impressions, the former being preferred. The impression is reinforced with plaster of Paris, which is also used in pouring the mold. The technic is simple and can be mastered by most practitioners.—*Mil. Surgeon*, 92:511, May 1943.

S. J. FANALE.

Dental Photography

By JESSE GOODMAN

PHOTOGRAPHY is important in clinical dentistry, teaching and research. It is of value as an aid in diagnosis and treatment planning in orthodontics, denture prosthesis, crown and bridge work, oral surgery and bite-raising. It is also valuable in jurisprudence. Procedures and equipment including cameras, lighting arrangements and accessories, are discussed in relation to standardizing dental photography. The types of films, together with methods of developing and printing, are also considered. Recommendations are made for various methods of filing and storing prints and transparencies. Two handy reference tables are presented, one for intra-oral photographs and one for extra-oral, full-face and profile photographs.—*Complete Photographer*, 4:1203, March 20, 1942.

M. J. SHEEHY.

Necrotic Gingivitis

By BASIL S. KENT

SEVERAL methods of treating necrotic gingivitis were carried out and results compared. Topical therapy and ascorbic acid sometimes cured mild and moderate cases, although results were inconsistent. Topical treatment was slow and ineffective and was liable to drive a severe case into a chronic stage. Massive sulfathiazole therapy was slow, but satisfactory, although more research is needed. An arsenical, mapharsen, applied directly on localized lesions and administered intravenously in cases where lesions were generalized, gave dramatic and swift results. The addition of vitamin C by mouth hastened recovery. Observations revealed that two distinct clinical conditions could be recognized: (1) pure latent scorbutic gingival ulceration and (2) Vincent's infection. Each showed a differentiating symptomatology. Differential diagnosis is thus necessary.—*Lancet*, 1:642, May 22, 1943.

S. J. FANALE.

Vitamin C Subnutrition in Gingivo-Stomatitis

By F. STUHL

IN seventy-four patients showing gingivostomatitis, forty-six were low in vitamin C, twenty-two were borderline cases, and six showed optimal saturation. Some cases were possibly prescorbutic. Although the Army dietary included adequate vitamin C, the method of food treatment in many camps caused the level to fall, especially because of oxidation. The beneficial effects of local treatment may have been enhanced by supplementing the diet with vitamin C.—*Lancet*, 1:640, May 22, 1943.

S. J. FANALE.

ANNOUNCEMENTS

ANNOUNCEMENTS must be received by the fifth day of the month in order to be published in the forthcoming issue of THE JOURNAL.

CALENDAR OF MEETINGS

AMERICAN ASSOCIATION OF PUBLIC HEALTH DENTISTS, Cincinnati, Ohio, October 10.

AMERICAN DENTAL ASSISTANTS ASSOCIATION, Cincinnati, Ohio, October 11-14.

AMERICAN DENTAL HYGIENISTS' ASSOCIATION, Cincinnati, Ohio, October 10-13.

AMERICAN SOCIETY OF ORAL SURGEONS AND EXODONTISTS, Cincinnati, Ohio, October 8-9.

UNIVERSITY OF BUFFALO DENTAL ALUMNI ASSOCIATION, Buffalo, October 19-21.

DISTRICT OF COLUMBIA DENTAL SOCIETY, second and fourth Tuesdays in each month, from October to June, at the United States Public Health Service Auditorium, Washington.

MONTREAL (CANADA) DENTAL CLUB, October 20-22.

NATIONAL BOARD OF DENTAL EXAMINERS, October 25-26; January 24-25, 1944; May 1-2, 1944.

GREATER NEW YORK DENTAL MEETING, New York, December 6-10.

NEW YORK SOCIETY OF ORTHODONTISTS, New York, November 8-9.

ROOT CANAL THERAPY ORGANIZATION, Chicago, February 1944.

STATE SOCIETIES

September

Southern California, at Los Angeles (13-15)

November

Ohio, at Cleveland (7-10)

January 1944

Rhode Island, at Providence

STATE BOARDS OF DENTAL EXAMINERS

California, at San Francisco, October 25 and at Los Angeles, November 29. Kenneth I. Nesbitt, 515 Van Ness Ave., San Francisco, Secretary.

Indiana, at Indianapolis, August 23-26. Carl A. Frech, Gary State Bank Bldg., Gary, Secretary.

Kentucky, at Louisville, November 16-19. W. F. Waltz, 1114 First Nat'l Bank Bldg., Lexington, Secretary.

North Carolina, at Raleigh, December 27. Wilbur Jackson, Rich Bldg., Clinton.

Ohio, at Cleveland, October 18-20; at Columbus, November 29-December 1. Earl D. Lowry, 79 E. State St., Columbus, Secretary.

Pennsylvania, at Philadelphia and Pittsburgh, October 19-23. Reuben E. V. Miller, 61 N. Third St., Easton, Secretary.

Wisconsin, at Milwaukee, November 8-12. S. F. Donovan, Tomah, Secretary.

AMERICAN ASSOCIATION OF PUBLIC HEALTH DENTISTS

The American Association of Public Health Dentists will hold its annual meeting in Cincinnati, Ohio, October 10, at the Netherland Plaza Hotel.

FRANK C. CADY, *Secretary,*
USPHS Hospital,
Lexington, Ky.

AMERICAN DENTAL ASSISTANTS ASSOCIATION

THE nineteenth annual session of the American Dental Assistants Association will be held in Cincinnati, Ohio, October 11-14, with headquarters at the Hotel Gibson.

AILEEN M. FERGUSON,
General Secretary,
709 Centre St.,
Jamaica Plains, Mass.

AMERICAN DENTAL HYGIENISTS' ASSOCIATION

THERE will be a special meeting of the House of Delegates and the Board of Trustees of the American Dental Hygienists' Association in Cincinnati, Ohio, October 10-

13. Headquarters will be at the Hotel Gibson.

A. REBEKAH FISK, *Secretary,*
Arlington, Va.

AMERICAN SOCIETY OF ORAL SURGEONS AND EXODONTISTS

THE twenty-fifth annual meeting of the American Society of Oral Surgeons and Exodontists will be held at the Netherland-Plaza Hotel, Cincinnati, Ohio, October 8-9.

HARRY BEAR, *Secretary,*
410 Professional Bldg.,
Richmond, Va.

UNIVERSITY OF BUFFALO DENTAL ALUMNI ASSOCIATION

The forty-second annual meeting of the University of Buffalo Dental Alumni Association will be held October 19-21, at the Hotel Statler, Buffalo, N. Y. The Eighth District Dental Society of the State of New York is cooperating. All ethical practitioners are invited to attend.

JOHN D. LYNCH, *Chairman of Publicity,*
University of Buffalo,
School of Dentistry,
Buffalo.

MONTREAL DENTAL CLUB FALL CLINIC

THE Nineteenth Annual Fall Clinic under the auspices of the Montreal Dental Club will be held at the Mount Royal Hotel, Montreal, Canada, October 20-22. For further information, apply to

M. L. DONIGAN, *Director,*
Drummond Medical Bldg.,
Montreal.

NATIONAL BOARD OF DENTAL EXAMINERS

The following are the dates for the next examinations of the National Board of Dental Examiners: October 25-26; January 24-25, 1944; May 1-2, 1944. The dates of the 1944 examinations are subject to change after the executive committee meeting of the Board in Cincinnati in October. Applications should be sent through deans.

GORDON L. TEALL, *Secretary.*

GREATER NEW YORK DENTAL MEETING

THE next Greater New York Dental Meeting will be held in the Hotel Pennsylvania, New York, December 6-10.

S. A. ISAACSON, *Chairman,*
Press and Publication Committee,
Room 106A,
Hotel Pennsylvania,
New York.

NEW YORK SOCIETY OF ORTHODONTISTS

THE fall meeting of the New York Society of Orthodontists will be held at the Hotel Waldorf-Astoria, New York, November 8 9.

NORMAN L. HILLYER, *Secretary,*
Professional Bldg.,
Hempstead, N. Y.

ROOT CANAL THERAPY ORGANIZATION

AT the Midwinter Meeting of the Chicago Dental Society, a national group for the study of root canal therapy was organized. W. Clyde Davis was made president, and John H. Hospers, secretary-treasurer. Committees were appointed to draw up a constitution and to select a name, to be submitted at the next regular meeting, in Chicago in February 1944. It is hoped that all those who are interested in this fundamental phase of dentistry will associate themselves with the group. Those joining before the final organization will be considered charter members. Annual dues were temporarily set at $2. All correspondence should be addressed to

JOHN H. HOSPERS, *Secretary,*
25 E. Washington St.,
Chicago, Ill.

SOUTHERN CALIFORNIA STATE DENTAL ASSOCIATION

THE next annual meeting of the Southern California State Dental Association will be held in Los Angeles, at the Ambassador Hotel, September 13-15.

ROBERT L. BORLAND, *Secretary,*
602 Chapman Bldg.,
Los Angeles.

OHIO STATE DENTAL SOCIETY

THE next annual meeting of the Ohio State Dental Society will be held in Cleveland, November 7-10.

EDWARD C. MILLS, *Secretary,*
255 E. Broad St.,
Columbus.

RHODE ISLAND STATE DENTAL SOCIETY

THE next meeting of the Rhode Island State Dental Society will be held in Providence in January 1944.

CHARLES F. MCKIVERGAN,
Secretary Pro Tem.,
102 Waterman St.,
Providence.

BOARD OF DENTAL EXAMINERS OF CALIFORNIA

THE next examinations to be conducted by the Board of Dental Examiners of California for licensure in the State of California will be held in San Francisco commencing October 25 and in Los Angeles commencing November 29. All credentials must be in the office of the secretary, Room 203, 515 Van Ness Ave., San Francisco, at least twenty days prior to the examinations. Address all communications to

KENNETH I. NESBITT, *Secretary*.

INDIANA STATE BOARD OF DENTAL EXAMINERS

THE next examination for a license to practice dentistry in Indiana will be held in Indianapolis, August 23-26. All credentials must be in the hands of the secretary at least ten days prior to the date of the examination. For application blanks and information, address

CARL A. FRECH, *Secretary*,
Gary State Bank Bldg.,
Gary.

KENTUCKY STATE BOARD OF DENTAL EXAMINERS

The next meeting of the Kentucky State Board of Dental Examiners will be held November 16-19, at the University of Louisville Dental School, Louisville. Dentists having graduated prior to 1943 and desiring to stand examination before this board must file applications, complete with full information requested, at this office not later than September 16. Applications of 1943 graduates must be in the secretary's office by October 16. Dental hygienists having completed a two year hygienist course and desiring to stand examination before this board must file applications by October 16. Ample time should be allowed for securing all data required. For application forms and further information, address

W. F. WALZ, *Secretary*,
1114 First Nat'l Bank Bldg.,
Lexington.

NORTH CAROLINA STATE BOARD OF DENTAL EXAMINERS

THE next meeting of the North Carolina State Board of Dental Examiners for the examination of applicants for licensure will be held at the State Capitol, Raleigh, beginning December 27. Applications must be filed with the secretary thirty days before the examination. For application blanks and further information, address

WILBUR JACKSON, *Secretary*,
Rich Bldg.,
Clinton.

OHIO STATE DENTAL BOARD

THE practical examination of the Ohio State Dental Board will be held at Western Reserve University School of Dentistry, Cleveland, October 18-20, and at Ohio State University College of Dentistry, Columbus, November 29-December 1. The practical examination may be taken either in Cleveland or in Columbus, provided due notice is given to the secretary. The theory examination will be held in Columbus, December 2-4. All applications must be in the hands of the secretary at least ten days before the examination. For further information, apply to

EARL D. LOWRY, *Secretary*,
79 E. State St.,
Columbus.

DENTAL COUNCIL AND EXAMINING BOARD OF THE COMMONWEALTH OF PENNSYLVANIA

THE Dental Council and Examining Board of the Commonwealth of Pennsylvania will meet in Philadelphia and Pittsburgh, October 19-23, to examine applicants for licensure to practice dentistry. For further information and application blanks, address the Department of Public Instruction, Bureau of Professional Licensing, Dental Division, Harrisburg.

REUBEN E. V. MILLER, *Secretary*,
61 N. Third St.,
Easton.

WISCONSIN STATE BOARD OF DENTAL EXAMINERS

THE Wisconsin State Board of Dental Examiners will conduct its next examination November 8-12, at Marquette University College of Dentistry, Milwaukee. For further information, address

S. F. DONOVAN, *Secretary,*
Tomah.

DENTAL INTERNSHIPS

THE Greater New York Conference of Hospital Dental Services, comprised of a group of men who are chiefs of dental services, would like to aid those men seeking dental internships in hospitals in the metropolitan area. Those who are not in the Army or the Navy and who are desirous of obtaining internships should communicate with

MARY E. REILLY, *Secretary,*
386 Fourth Ave.,
New York, N. Y.

DIRECTORSHIPS OPEN IN WEST VIRGINIA STATE HEALTH DEPARTMENT

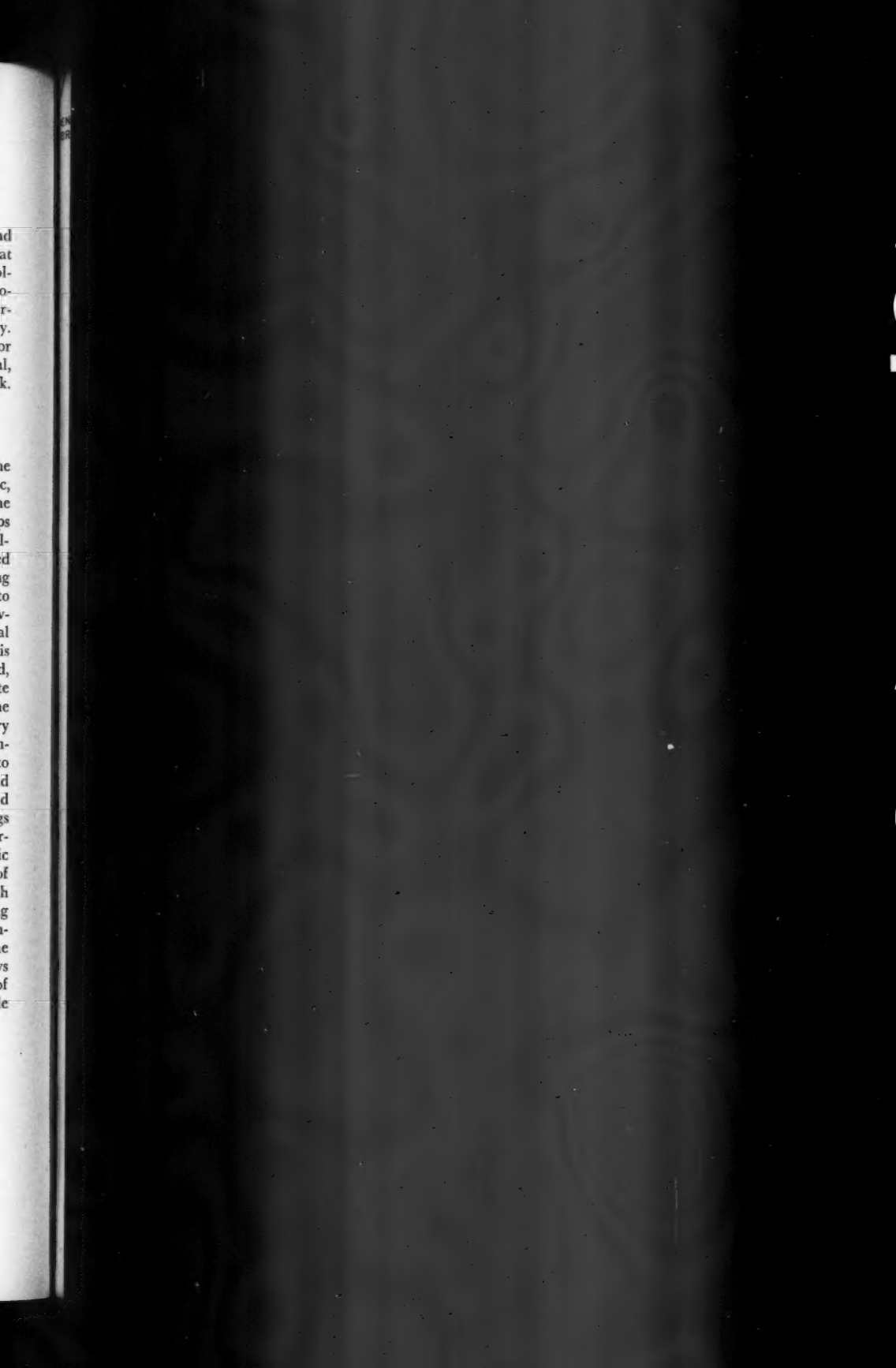
UNASSEMBLED examinations are announced for positions in the West Virginia State Health Department. Applications will be accepted continuously, but new registers will be established from applicants who file no later than June 26. Positions for which applications are now accepted, together with salary ranges, are as follows: Director, Bureau of Dental Hygiene, $3,840-$4,500; Director, Public Health Education, $2,640-$3,240. Appointments may be made at above the minimum salaries. Residence in West Virginia has been waived in consideration of applicants for these positions. Address communications to

ROBERT F. BINGHAM, *Supervisor,*
212 Atlas Bldg.,
Charleston.

VOLUNTEERSHIPS AND EXTERNSHIPS, BRONX HOSPITAL

THERE are several volunteerships and externships available for recent graduates at the dental clinic, Bronx Hospital, in the following departments: oral surgery and exodontia, operative dentistry, orthodontia, surgical periodontia and root canal therapy. Applicants address David Wurzel, director of the Dental Department, Bronx Hospital, 169th St. & Fulton Ave., Bronx, New York.

CARNEGIE FELLOWSHIPS FOR RESEARCH AND GRADUATE WORK IN THE DENTAL SCIENCES

AIDED by the Carnegie Corporation of the New York and the Eastman Dental Clinic, the School of Medicine and Dentistry of the University of Rochester offers scholarships paying $1,200-$1,800 per annum to well-trained dental graduates who are interested in research or who desire special training in the basic medical sciences as an aid to dental teaching or practice. A few fellowships also offer part-time training in oral surgery. On appointment, the applicant is given the title of Fellow in Dentistry and, according to his interest, works as a graduate student in one of the departments of the medical schools. Here, excellent laboratory facilities, adequate direction and close contact with various investigations related to medicine and dentistry help his research and study. Fellows are encouraged to attend medical classes, seminars and staff meetings and, when opportunity presents itself, to participate in class instruction and scientific meetings. Contact with the problems of clinical dentistry may be maintained through the Oral Surgery Clinic of the Strong Memorial Hospital and the Rochester Dental Dispensary. With the approval of the Graduate Council of the university, Fellows may prepare themselves for the degree of M.S. or Ph.D. Applications should be made to

GEORGE H. WHIPPLE, *Dean,*
Rochester, N. Y.